ELECTRICAL REVIEW

FOUNDED 1872

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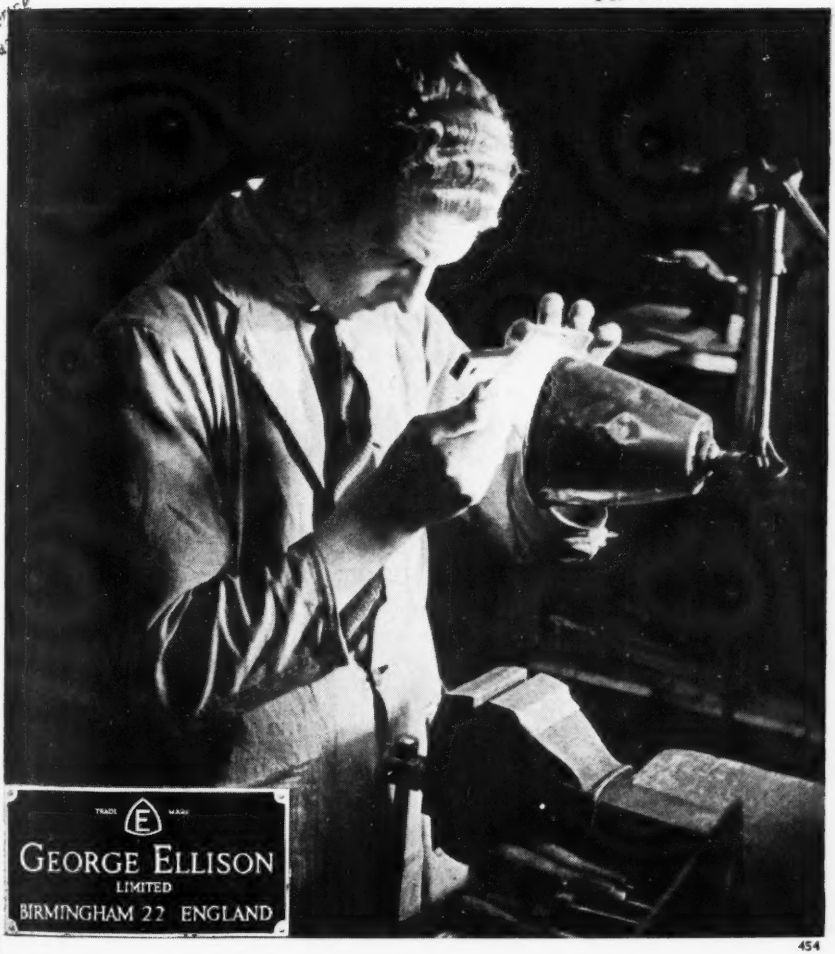

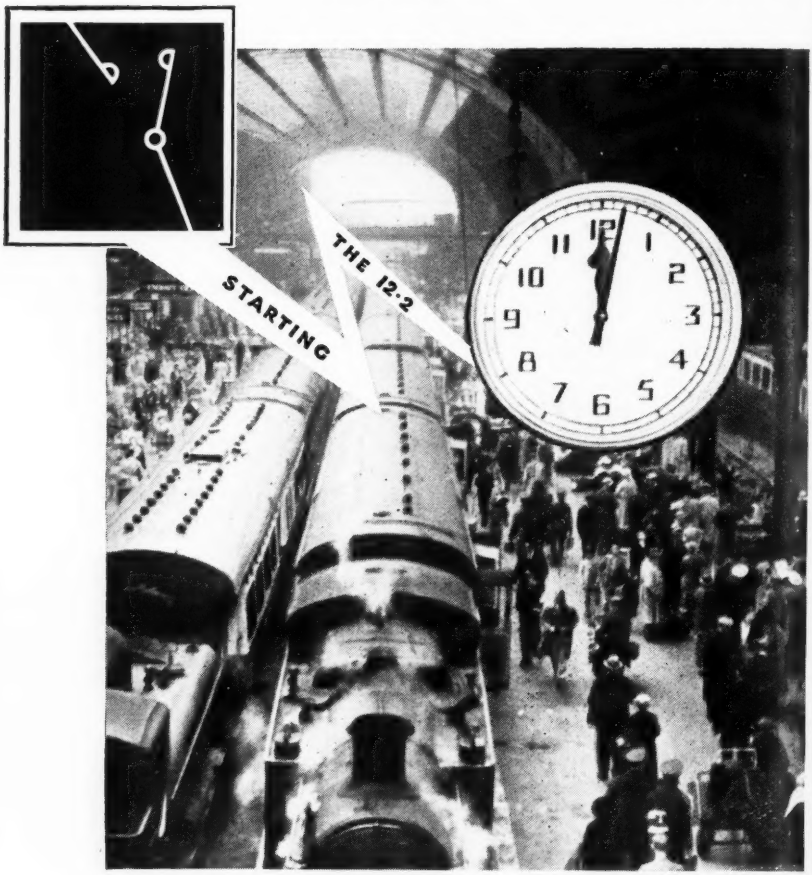

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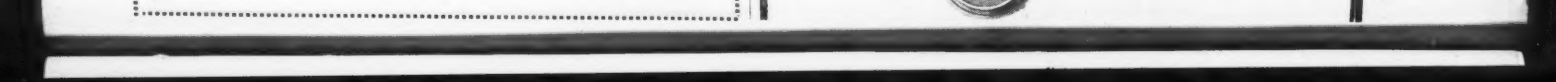

ELECTRICAL REVIEW

Volume CXXX No. 3356

Friday, March 20, 1942

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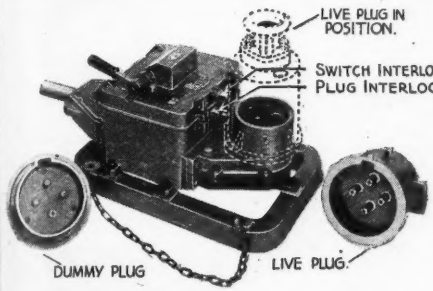

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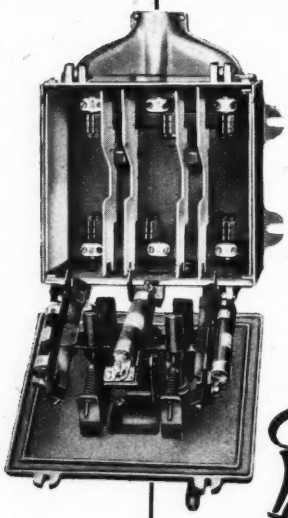

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ELECTRICAL REVIEW

THE OLDEST ELECTRICAL PAPER — ESTABLISHED 1872

Vol. CXXX. No. 3356. MARCH 20, 1942 6d. WEEKLY

Engineering Education

Proper Training for the Right Men

DISCUSSIONS about the status of engineers in the community usually bring up the question of how far conventional methods of training students fulfil the main purpose, which is to apply most efficiently the resources of nature to the benefit of all. To do so involves the attainment of a breadth of view that takes in the social bearing of engineering, no matter how inconspicuous an individual's contribution may appear to be. Most engineers agree that the present position is not satisfactory, but there is not the same general agreement as to how improvements can be made.

A gratifying feature of the comprehensive and constructively "Critical Review of Education and Training for Engineers," which Dr. A. P. M. Fleming presented yesterday (Thursday) evening at the Institution of Electrical Engineers, was its insistence on the development of understanding and initiative as the basic requirement.

Purpose of Examinations

As an example of the real need to differentiate between ends and means, there is the possibility that success in passing examinations may be regarded as an end in itself instead as a rough test of the amount of raw material stored in the mind and still awaiting assimilation. That is to say the value of the technical information acquired depends upon the ability of the student to make use of it.

While the self-discipline entailed in acquiring the necessary grounding of technical knowledge is a good thing in itself, the gain may be more than offset if the hard grind it entails leaves no time or energy for keeping alive other cultural interests or for taking a share in corporate activities, both of which are essential to the preservation of the suppleness of mind requisite for the judicial reception of new ideas. To strike a true balance between conflicting claims on the attention of students is one of the most difficult tasks of the educationalist. Indeed, little can be accomplished except on a national scale, in the framework of which the importance of works apprenticeship should receive adequate recognition.

Gauging Suitability

Linked up with educational betterment is the need to remove any causes of a sense of frustration that is likely to lead to dissatisfaction with working conditions. Apart from students who are clearly unsuited to an engineering career and who should be eliminated in the earliest stages, there are those who are over-educated, academically, for their capabilities and those who find no suitable scope for their talents owing to lack of balance between entry into technical colleges and the capacity of industry to absorb them in appropriate progressive employment afterwards. Common to all is the debilitating feeling (which ought to be removed at once) that they are regarded merely as automotive machines. Finally, there is the need to make the utmost of the diversity of talents and abilities without any regard

to the financial circumstances of youths of the right kind. In the paper discussed yesterday, which is the product of its Sub-Committee for Education, Training and Personnel, the I.E.E. Post-War Planning Committee has already given signal justification for its existence. In this paper, the Sub-Committee furnishes an apt illustration of the value of the faculty of "critical analysis" which it recommends that students should cultivate. Education and training are essentially a major concern of the Institution, but the carrying through of both long and short-term policies in the difficult years after the war will call for the maintenance of not less than the present collaboration with Government Departments and other senior engineering bodies.

Cheques for the Enemy

CANCELLED cheques are a sad reminder of the speed with which the citizen and his money are parted and yet many people like to keep them—not to look at, of course, but in the belief that they constitute valid receipts. Legally they do not, although they might be put in as evidence of the payment of an account. In any event banks provide regular statements to customers and these constitute a record of payment. Cancelled cheques have a much more important function to perform nowadays—as components of vital munitions. Readers are therefore asked to turn over to the waste-paper collectors all their old cheques or ask their bankers to do so. They are reminded, however, that this is only one aspect of the matter; there are hundreds of other classes of unwanted paper which should be similarly dealt with.

Lighting Voltage

THE commentary on industrial installations given by Mr. L. C. Grant before the I.E.E. Installations Section last week produced a discussion that showed the healthy interest of its members in a most important subject. The majority of the participants "followed the hare" of the most suitable lighting voltage. While there are special cases (*e.g.*, in the use of portable lamps in damp situations and in temporary building operations) where the voltage should be transformed locally to not more than 50, a departure from the standard 230 V, thereby incurring the squared voltage-drop increase, can hardly be justified in ordinary circumstances on safety grounds in view of the microscopic percentage of industrial accidents that can be attributed to electric shock.

Reactor Standards

ALTHOUGH the recognised standards for the construction of current-limiting reactors are the same as for power transformers, B.S.S. 171/1936 does not cover the most important function of the former, namely, its performance on short circuit. The proposals contained in a paper read by Messrs. J. G. Wellings and R. V. Wheeler before the I.E.E. Transmission Section appear to provide a suitable basis for common tendering. The assumption made of infinite kVA of generating plant connected to the system might seem at first glance to be unduly conservative but, having regard to mounting short-circuit values and the great convenience of the reference standard, it is no doubt justified.

American Adaptation

THERE is no exact counterpart of the Edison Electric Institute in Great Britain. The E.E.I. exercises a variety of functions which in this country are divided among many bodies who are often not sufficiently in touch with one another. It sponsors both technical and commercial development and acts as a clearing house for electricity supply statistics. Codes and standardisation also come within its purview. Part of its work is similar to that carried out here by E.D.A. and it is interesting to see that it has similarly had to adapt its activities to wartime conditions. If the electrical industry cannot at present advance in some directions the measures adopted will at least prevent retrogression.

A Great Teacher

IMMENSE as were the attainments in physics of Sir William Bragg, it seems inappropriate to refer to him as a "scientist", with all the human limitations conventionally attached to the term. He was so much more. It was his possession of a rare imaginative insight into the intellectual needs of others from childhood onwards, associated with a complete absence of any feeling of superiority over those less gifted than himself, that made him so fine an exponent of scientific principles. A knowledge of at least the elements of these he held to be desirable among all members of society.

Heavy Quarrying

Electrical Applications in Ironstone Winning

A DAY recently spent at the workings of the Irchester Ironstone Co., Ltd., a subsidiary of the Cargo Fleet Iron Co., Ltd., was more than usually interesting because of the use at the quarry of a mammoth excavator supplied by Ransomes & Rapier, Ltd., which, weighing over 600 tons, is among the largest in use in this country. It deals with 8 cu. yd. of material at a time, is entirely electrically operated and houses something like 500 HP of motive equipment. It is hoped to describe the electrical installation and operation of this excavator in detail in a later issue.

To deal with the very deep overburden, up to more than 60 ft., a mammoth electrical excavator with approximately 500 HP of motive equipment is used

There are two pits at the site—Lodge and Wembley—but as the latter is on the point of being closed down because the area is practically worked out, we will deal mainly with the former. The Lodge pit is horseshoe in shape, mainly for convenience of operation and because of the shape of the ironstone deposit being worked. The ironstone exists under an overburden consisting of clay and sand covered by a strong course of limestone, the depth varying from about 24 ft. at the centre of the face to over 60 ft. The face is about ¾ mile long and the two major operations are the removal of the overburden and the removal of the rock. A cut of about 40 ft. wide is made into the overburden by the Baring excavator which travels on top of the ironstone bed. The rock loading shovel follows with a cut of similar width, standing at the foot of the rock face, the ironstone being loaded into wagons. A 4-ft. 8½-in. gauge track runs along the face opened up, and this is moved forward as the face advances. The overburden is dumped in front of the face, that is, on ground from which the rock has been previously removed. It takes about three months to complete these operations from end to end of the face.

So far it has not been necessary to prepare the overburden in any way for its removal by the large excavator, although, owing to the strong nature of the limestone bed, it may ultimately be necessary to resort to blasting. Considering that the bucket holds over 10 tons of material this is a remarkable achievement which reflects the fact that the development of such mammoth excavators has somewhat revolutionised quarrying operations where there are deep overburdens, at least from the economic aspect. The excavator has a dump radius of 114 ft., that is, from its centre to the maximum tip, and it will dump up to 70 ft. high. Even this dump height is not sufficient, however, for working at the deeper part of the face, so a secondary, or relay, overburden removal is necessary.

The overburden and rock excavators are situated on the top of the rock seam and at the foot of the rock face; dragline on right, compressor in foreground

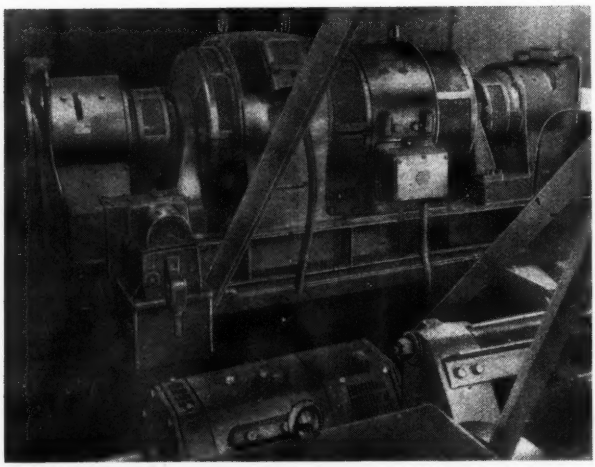
The re-handling of some of the overburden is effected by a Ruston-Bucyrus dragline excavator, equipped with a 60-ft. boom and a 2½-cu.-yd. bucket, which is capable of dealing with 125 cu. yd. per hour. This is a single-motor equipment, the three motions of hoisting, dragging and rotating being all actuated by the 100-HP, 3.3-kV, AC induction unit via

band-type clutches. The main transmission from this motor is by oil-immersed helical gearing. The clutches are air operated, the air supply being provided by a 2-HP, 400-V motor-driven compressor aboard the plant. The bucket is suspended from the boom by a single hoisting rope and pulled towards the machine by means of a drag rope which is attached to a winding drum. When working the operator can throw the bucket out a considerable distance beyond the end of the boom.

Rock Excavating

Where a cut into the overburden has been completed, the top of the 10-ft. bed of ironstone is exposed, and in preparation for excavation the rock is first broken up by blasting. For this purpose holes about 6 ft. deep and with about 6-ft. spacings are pneumatically drilled from the top of the seam for subsequent charging with explosives and firing. For supplying the pneumatic drill there is a portable motor-driven air compressor which consists of a two-stage Ingersoll-Rand compressor which will supply 216 cu. ft. of free air per minute at 100 lb. per sq. in. This is directly coupled to a 47.5-HP, 3.3-kV, 725-RPM induction motor, which is supplied by trailing cable from the rock shovel. The shovel is a Ransomes & Rapier equipment, which has a bucket capacity of about 2¼ cu. yd. and will handle about 1,000 tons a day. It is a self-propelling caterpillar machine. Apart from the travelling, which is cared for by the hoisting motor, there are three motions, hoisting, slewing and crowding. These are served by 60-, 20- and 20-HP motors respectively, all 230 V, DC, which are supplied from separate generators on a motor-generator set by which Ward-Leonard control is effected for reversing, speed regulation and efficient peak load stalling. The motor-generator set motor is a 100-HP, 1,460-RPM induction unit, and the hoist, rotate and crowd generators are 50-, 20- and 20-kW machines, respectively.

The hoist generator has three independent windings on the main poles, namely, a separately excited winding regulated by the controller, a heavy differential series winding which controls the generator voltage according to the current flowing in the armature circuit, and a self-excited shunt winding which amplifies the difference of the other two windings. Under certain conditions the series winding predominates over the separately-excited winding and then the self-excited winding follows the series winding, the polarity of which is the same. The hoist motor has only one main field winding, which is separately excited from the 125-V exciter component of the motor-generator set. On the hoisting side the field is brought up to a maximum on the fifth point of the controller and is maintained at that degree to the last point. On the lowering side the field is weakened again on the last two points in order to give fast deceleration.



The motor-generator set is situated right across the back of the rock shovel cabin

The combined action of the field windings on the generator causes the voltage of the generator to depend on the current taken by the motor, the voltage being reduced as the current decreases, so that the generator characteristic is reproduced by the motor in the form of a torque-speed curve. A high value of torque is maintained from stalling up to normal speed, after which the torque rapidly falls off until a definite light running speed is attained. The hoist motor is also used for travelling, the motor being first declutched from the hoist drum and then coupled to the travelling gear. The swing motion is very similar to the hoist motion, except that the controller is arranged to maintain motor field at full strength from the fifth point onwards in both directions to give the same characteristic whichever way the controller is operating. The crowd motion is

similar to the swing motion and a brake is so operated by the controller that it is automatically applied when the controller is brought to the off position and released as

The crowding motor of the mammoth excavator is 40 ft. or so up the boom

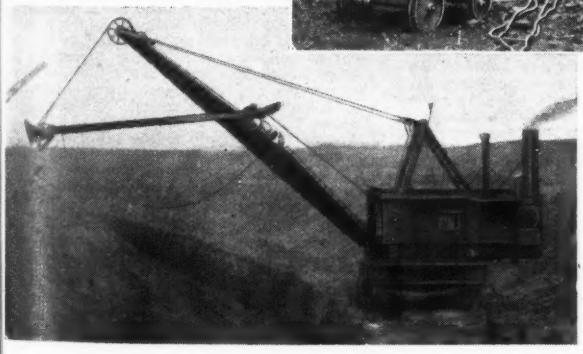
soon as the controller lever is moved away from the off position.

The shovel is supplied at 3.3 kV by a 0.0225 sq. in. armoured trailing cable. This is first taken through the vertical travelling shaft at the centre of rotation to a slip-ring collector box at the top of the equipment. The ironstone when blasted is loaded by the excavator into 10-cu.-yd. wagons, which are transported to the calcining clamps by steam locomotives.

Calcining

Calcining is a long-term burning process during which much of the moisture content of the rock is removed, so that the proportion of iron is increased and there is considerably less weight of rock to be transported to the blast furnaces. The loaded tip wagons are taken to the top of a gigantic heap or clamp and tipped sideways on to a thick layer of coal, which is, of course, the ignition medium. A small proportion of coal slack is unloaded on top of the clamp and mixed with the ironstone after it has been tipped. It takes several months to complete the calcining of a clamp, depending on the nature of the ironstone and the size of the clamp. During the building of the clamp the larger lumps of rock are broken up by blasting. The holes are drilled dry by a portable electric drill manufactured by Siemens Schuckert (Great Britain), Ltd. This employs a spiral fluted steel drill carrying a $1\frac{11}{16}$-in. diameter drilling bit tipped with "Wimet." The incorporated driving unit is a $1\frac{1}{4}$-HP, 600-RPM fan-cooled motor which is controlled from a switch in the handle of the tool.

The 125-V, three-phase drill is supplied by



Above: The drill at the calcining clamp is supplied from a special transformer

Left: The large steam excavator at the Wembley pit has been adapted for electrical stoking and forced-draught firing since the installation of the electric rock-loading shovel

a five-core trailing cable from a 1.5-kVA, 400/125-V portable transformer in which are incorporated special arrangements for the protection of the drill. The fifth core of the trailing cable is a pilot which operates a contactor when the leakage voltage reaches 20. Inside the transformer is a t.p. circuit-breaker with three thermal and three magnetic overload releases connected to the 400-V side of the transformer. The circuit-breaker embodies an earth-leakage device which is connected between the star point of the low-voltage side and earth and operates at a leakage-to-earth potential of 20 V. The transformer is supplied via a trailing cable and plug points on the poles of a 400-V overhead line.

At the moment it is possible to remove the considerable quantities of water from the quarry by natural drainage into a nearby brook, but Mr. W. Wolf, the mines manager, to whom we are indebted for help in the preparation of these notes, expects soon to be forced to increase his electricity consumption through pumping operations.

An interesting point is that at the Wembley pit there is the largest steam excavator in the country in which electrical stoking and forced-draught firing have been adopted to attain smokeless combustion. Further, the operation of the bucket door latch has also been converted from hand to electrical release.

In connection with water-softening processes for the steam navvies and locos. there are several motor-driven pumps. For the two quarries over 2,000 HP of motors has been installed.

A supply at 11 kV is received at a switching station about a quarter of a mile from the centre of the quarry, and from this point the company transmits by overhead line at the same voltage to a transformer station near the quarry face. At this station there is a 1,000-kVA transformer by which a supply is afforded at 3.3 kV by a Reyrolle, 400-A metal-clad switch panel with earth-leakage protection and t.p. internal earthing. This switch panel serves a surface-laid, three-core, p.i., l.c., d.w.a., 0.1-sq. in. cable running in either direction around the quarry face. This semi-permanent cable, supplied by Callender's Cable & Construction Co., Ltd., which must be moved forward about every three months as the quarry face is advanced, is spaced at every 100 yd. by Ellison cable-end boxes from which the trailing cables supply the quarry equipment. These are Metropolitan cables, the one for the large excavator being four-core, 0.075 sq. in., and that for the small or rock excavator being four-core, 0.0225 sq. in.

Our thanks are due to the Irchester Ironstone Co., Ltd., for permission to visit the quarry and to take photographs.

Contractors' Notes

REFERRING to a recent statement on holidays in industry by the Ministry of Labour and National Service, the Director of the Electrical Contractors' Association (Mr. L. C. Penwill) has drawn the attention of his members to the provisions of the agreement between the E.T.U. and the National Federated Electrical Association. In some districts work on Good Friday must be paid for at the rate of time and a half. Generally speaking, following the advice of the Ministry, no work will be done on Easter Monday, Whit Monday or August Bank Holiday. The rate for such work as is done should be paid for at the rate of time and a half.

Working Hours Limit

The restrictions imposed by the Factories Act, 1937, upon the number of hours which may be worked by women and employees under eighteen years of age do not apply to employees engaged upon "works of building construction." The Association's solicitors have expressed the view that the ordinary activities of electrical contractors in connection with buildings come within this provision and that they are therefore excepted from the restrictions.

Where members employ women or young persons on their own premises, however, these employees may still be subject to the restrictions on hours.

Travelling Time and Fares

Under Clause 13 (d) of the National Working Rules the payment of railway fares and travelling time to an employee working over 200 miles from the shop is a matter for arrangement between the employee and his employer. It has been suggested by the National Joint Industrial Council for the industry that for all average conditions the payment of fares and travelling time to men working over 200 miles from the shop should be made at not greater intervals than six months.

Use of Cycles

Mr. Penwill says that certain branches of the Electrical Trades Union have advocated the acceptance of a working rule that employees shall be forbidden to use cycles while in employers' service. As a result of consideration of the whole matter, the National Joint Industrial Council has adopted the following as a statement of policy: "It is hereby agreed by the joint parties to this agreement that they deprecate the practice of employees using cycles or mechanically propelled vehicles in a dangerous manner."

We are told that this matter arises out of the possibility of an employer making the possession of a bicycle a condition of employment, and in any event a man on a cycle loaded with conduit is likely to encounter or cause trouble.

Withdrawal of Women

It is emphasised that the Ministry of Labour's recent decision to withdraw from the retail trades all women aged 26–30 at the date of their registration applies only to women employed on the retail side of a contractor's business.

Short-Circuit Currents

Co-ordinating Cable Size with System Characteristics

By E. A. Beavis,
A.M.I.E.E.

Following up his previous article, the author deals with the necessity for ensuring that cables are of a sufficient size to withstand the large fault kVA likely to be experienced on modern systems

IN an aricle in last week's ELECTRICAL REVIEW particulars were given of the effects of a bomb explosion on a 0·023 sq. in. 6·6-kV cable connecting a main substation with a secondary substation about 700 yd. away. Five severe breakdowns, apart from the original damage at the crater, occurred on this cable, in contrast with the freedom from such consequential faults shown by a 0·1 sq. in. cable running alongside throughout the route. The present article indicates the possible short-circuit currents involved and discusses the relationship between size of cable, kVA fault capacity and time-delay in switch operation.

The initial short-circuit current can be calculated from a knowledge of the percentage resistance and reactances of the various component parts of the circuit. These values are usually given with reference to some standard kVA capacity, for instance 100,000 kVA. The variable factor during the time period of the "short" will be the characteristics of the cable in which the breakdown has occurred, since the rise in temperature occasioned by the heavy current increases its resistance and so renders the percentage impedance of the circuit greater. The degree of decrement of the short-circuit current will depend chiefly upon the value of this resistance as compared with the total impedance of the system, since the effect of the resistance of cables in the circuit on the step-up side of the substation will in general be very small.

This means that the reduction of the current with continuing short-circuit, apart from any change in fault resistance, which is an unknown factor, is practically dependent upon the size of cable concerned. If R_p and X_p represent the percentage values per 100,000 kVA on the system up to the substation, R and X the percentage values for the cable from substation up to the fault position under normal conditions, *i.e.*, just previous to breakdown, then the short-circuit kVA available at the fault will be equal to

$$\frac{100{,}000 \times 100}{\sqrt{(R_p + R)^2 + (X_p + X)^2}}.$$

The initial short-circuit current, I, will be $\frac{\text{S.C. kVA} \times 1000}{\sqrt{3} \times 6600}$. If the conductor resistance of the cable from substation to fault be r initially, then $r = r_o(1 + a\theta_o)$, where r_o is the basic resistance at 15 deg. C., θ_o is the rise above this just previous to the short-circuit and a is the resistance–temperature coefficient per deg. C. (0·004 for copper). After the short-circuit current has been flowing for

CALCULATED TEMPERATURE RISE OF CONDUCTORS AND CURRENT DURING PERIOD OF SHORT-CIRCUIT.

Time in secs.	Short-circuit current Amperes	Temperature rise, deg. C. Case 1 0·023-sq. in. cable	Case 4 0·05-sq. in. cable	Short-circuit current Amperes	Temperature rise deg. C. Case 2 0·023-sq. in. cable	Case 4 0·05-sq. in. cable	Short-circuit current Amperes	Temperature rise deg. C. Case 3 0·1 sq. in. cable
0	4900	0	0	12500	0	0	13200	0
0·05	—	—	—	7920	260	27·4	—	—
0·1	4070	51·5	9·6	6290	445	42·0	—	—
0·2	3540	95·8	17·0	4750	733	60·8	—	—
0·25	—	—	—	—	—	—	12300	50
0·3	3180	135	22·8	—	—	—	—	—
0·5	2700	203	32·0	—	—	—	11200	100
0·76	—	—	—	—	—	—	10400	150
0·9	2150	307	43·9	—	—	—	—	—
1·02	—	—	—	—	—	—	9600	200
	Initial temperature 15 deg. C. Fault in 0·023-sq. in. cable, 708 yd. from main substation			Initial rise above basic temperture 0·023-sq. in. cable, 200 deg. C. 0·05-sq. in. cable 32 deg. C. Fault in 0·023-sq. in. cable 152 yd. from main substation			Initial temperature 15 deg. C. Fault in 0·1 sq. in. cable, 708 yd. from main substation	

t seconds the resistance rises to r_t due to the increased temperature, and $r_t = r_o(1 + a\theta_o + a\theta_t)$, where θ_t is the extra rise caused by the fault current.

The percentage resistance will increase similarly, to a value R_t so that the fault current decreases and $\left(\frac{I_t}{I}\right)^2 = \frac{(R_p + R)^2 + (X_p + X)^2}{(R_p + R_t)^2 + (X_p + X)^2}$

Now the rate of rise of temperature with time at t seconds is :— $\frac{d\theta}{dt} = \frac{I_t^2 \cdot r_t}{4 \cdot 2SW} = \frac{0 \cdot 012 I_t^2 (1 + a\theta_o + a\theta_t)}{A^2 \times 10^6}$, where S is the specific heat, W is the weight, and A the cross-section in sq. in. Substituting for I_t in terms of I, and simplifying, then :—

$$d\theta\left[R_o^2(1 + a\theta_o + a\theta) + 2R_oR_p + \frac{R_p^2 + (X_p + X)^2}{1 + a\theta_o + a\theta}\right] = dt.\ K[(R_p + R)^2 + (X_p + X)^2]\ ;\ \text{where } K = \frac{0 \cdot 012\, I^2}{A^2 \times 10^6}.$$

Hence $\theta\left[R_o(R + 2R_p)\right] + \frac{\theta^2}{2} \cdot R_o^2 a + \frac{1}{a}\left[R_p^2 + (X_p + X)^2\right] \log_e\left(\frac{1 + a\theta_o + a\theta}{1 + a\theta_o}\right) = t.K\ [(R_p + R)^2 + (X_p + X)^2]$.

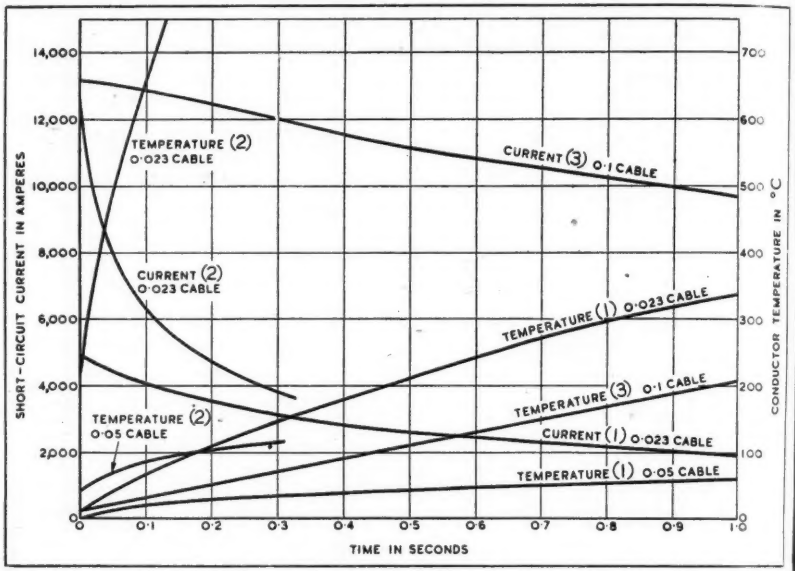
Effect of Cross-sectional Area

(1) If the cable in which the "short" occurs is of comparatively small area, and has therefore a high resistance, so that the reactance and resistance of the rest of the circuit are negligible by comparison, the above formula can be simplified to:—

$$\theta = \left(\frac{1 + a\theta_o}{a}\right)\left[(2aKt + 1)^{\frac{1}{2}} - 1\right].$$

(2) If on the other hand the cross-sectional area of the cable is large, so that the increase in resistance due to temperature rise is inappreciable in comparison with the total circuit impedance, then the short-circuit current remains practically constant. In this case $\theta = \left(\frac{1 + a\theta_o}{a}\right)\left[e^{a^2Kt} - 1\right]$.

Case 1. With the initial short-circuit in the 0·023-sq. in. cable, the conductor resist-



Conductor temperatures and short-circuit currents resulting from cable breakdowns. (1) and (3) 708 yd. and (2) 152 yd. from main substation

Case 2. In the case of the second short-circuit in the 0·023-sq. in. cable, as the length is much shorter the conductor resistance is reduced, and as a result the total reactance of the system must have a modifying influence on the value of the current. The actual conditions regarding this failure, however, are not exactly known; a tentative assumption is made that the high temperature—possibly well above 200 deg. C.—was responsible for the breakdown. If so, the high initial temperature would nearly double the normal resistance and so tend to make it again the paramount factor in the circuit

impedance. In these circumstances there is no point in making elaborate calculations of the percentage impedances concerned, as the approximate current can be determined by the simplified formula with sufficient accuracy.

Case 3. In order to obtain for comparison the approximate temperature rise and short-circuit current in the 0·1-sq. in. cable which, as mentioned in the earlier article, was damaged at the same time as the 0·023-sq. in. cable and tripped out on fault conditions at the main substation, it is necessary to take into account the total impedances operating in the system, and the change effected by increased resistance of the cable with rising temperature.

Case 4. The effect of the resistance of the short piece of 0·05-sq. in. cable in series with the smaller cable is negligible, but as it is traversed by the same short-circuit current, the temperature it attains is worthy of consideration for comparison.

The rate of rise in temperature for the 0·05-sq. in. cable at time t seconds after the start of short-circuit will be given by :— $\frac{d\phi}{dt} = \frac{0{\cdot}012\,I_t^2}{A_1^2\times 10^6}(1+a\phi_0+a\phi_t) = K_1\left(\frac{I_t}{I}\right)^2(1+a\phi_0+a\phi_t)$, where ϕ_0 is the initial temperature just previous to the short-circuit, and $K_1 = \frac{0{\cdot}012\,I^2}{A_1^2\times 10^6}$. Considering the simplified formula for condition (1), in the case of the 0·023-sq. in. cable $\frac{d\theta}{dt} = \frac{K(1+a\theta_0)^2}{1+a\theta_0+a\theta_t}$, and so for the 0·05-sq. in. cable, $\frac{d\phi}{dt} = \frac{K_1(1+a\phi_0+a\phi_t)(1+a\theta_0)^2}{(1+a\theta_0+a\theta_t)^2} = \frac{K_1(1+a\phi_0+a\phi_t)}{K(1+a\theta_0+a\theta_t)}\cdot\frac{d\theta}{dt}$. That is:- $\frac{d\phi}{1+a\phi_0+a\phi_t} = \frac{d\theta}{1+a\theta_0+a\theta_t}\times\frac{K_1}{K}$, and from this expression, $\phi = \left(\frac{1+a\phi_0}{a}\right)\left[\left(\frac{1+a\theta_0+a\theta}{1+a\theta_0}\right)\frac{K_1}{K}-1\right]$. The ratio $\frac{K_1}{K} = \left(\frac{A}{A_1}\right)^2$, *i.e.*, the inverse square of the ratio of cross-sections, and is in this case equal to 0·202. Calculations have been made of the temperature rise and the short-circuit current for these particular cases, and the results are given in the accompanying table. The values have been plotted in the curves reproduced.

It is evident that calculated figures for temperature rise must always tend to overestimate the actual values, since there are always unknown impedances present in the switchgear, the fault itself, and the return path, which will reduce the estimated maximum short-circuit current. Also it is assumed that all heat is absorbed by the copper and none dissipated into the surrounding insulation during the period of short-circuit, which again creates the maximum possible temperature effects. All this is beneficial in that it gives conservative values and provides a factor of safety, but it must also be borne in mind when considering sizes of cables required to meet short-circuit conditions.

Conclusions

A consideration of the circuit conditions prevailing makes it evident from the very outset that the 0·023-sq. in. cable is too small a size to be able to deal with the large fault kVA capacity available—which approximates to 260,000 kVA at the main substation. A factor contributing largely to the excessive damage occasioned was the comparatively long time delay in the switch tripping arrangements; with a minimum setting of practically 0·9 sec. for the relay and a switch action taking 0·4 sec., there was a total of almost 1·3 sec. Had this operation been much quicker, say 0·4 sec. or less, the temperature would not have reached 200 deg. C., and the deterioration in the cable would not have been excessive; in fact the cable might still have been workable and the second breakdown probably avoided.

However, although a shorter time-element in the trip operation would possibly have saved the cable in this instance, it obviously could not do so in the case of a short-circuit occurring much closer to the supply station. The 0·05-sq. in. cable which has sustained the same short-circuit currents shows only slight deterioration and according to the calculations the temperature has not exceeded 100 deg. C., but it is possible that a further instantaneous "short" may have occurred in this cable at the time the joint box blow-out took place (No. 1 fault). The 0·1 cable appeared to be entirely unaffected by the short-circuit, although the temperature approached 200 deg. C. before cut-out occurred, and is continuing in service.

There is no doubt that if the fault had occurred much nearer to the main substation the temperature reached would have been very much higher during the prolonged period of short-circuit and might have resulted in damage to a few of the core-papers. The cable would obviously be safer with a shorter time-lag on the protective relay.

Size of Cables

It would seem that with modern methods of transmission and distribution, which tend to the creation of substations of fairly large capacity, having the bulk supply of the grid or of a large generating station behind their busbars, the sizes of the supply cables radiating from these substations must be governed largely by the short-circuit kVA available to supply fault-current, if the risk of severe damage is to be avoided. Similar conditions also apply to internal station

plant, when auxiliary equipment is fed from the main switchboard or from large secondary boards. In many cases such a consideration would necessitate the employment of much larger cables than required by actual load conditions, with a correspondingly excessive expenditure on copper.

The problem is concerned mainly with feeder cables and distributors and from the evidence obtained it refers more especially to cables up to a size of 0·1 sq. in., as larger sizes would appear to have the necessary factor of safety to be reasonably secure in service. Transmission cables are usually well safeguarded by the circuit characteristics in conjunction with better protective facilities. In order to ascertain the minimum size of cable required in any particular case, it is necessary to determine first of all the maximum temperature to which the installation can be subjected without suffering definite deterioration. The word installation is used here advisedly as the cable is not the only item to be considered although it may be the most important; there are in addition the switchgear and the joints.

Other Heating Effects

The heating due to short circuit may not only damage the cable insulation, but may result in excessive expansion, tending to snake the cable and cause stress at the joints, which will separate the conductors if the solder softens in the jointing ferrules; severe strain may also be imposed on the end boxes. The mechanical forces due to the magnetic effects of the current in general appear to be of less importance with regard to the cable, being more associated with the switchgear.

The question of maximum temperature permissible is difficult to determine as the time element is of so much importance. The limits for short-circuit current so far put forward have been based on a maximum temperature rise in the conductor of about 100 deg. C. at the end of the short-circuit period, which means that the extra rise in temperature permissible during the breakdown is only 50 deg. C. above the working temperature of the cable. On this basis, taking for example the 6·6 kV substation with 260,000 kVA short-circuit capacity, the maximum fault current for which is 23,000 A, the minimum size of cable allowed would be 0·25 sq. in. for a 0·2 sec. break, 0·3 sq. in. for a 0·5 sec. break and 0·4 sq. in. for a 1·0 sec. break.

These sizes would certainly seem to provide an adequate safety factor; the only consideration is whether they tend to be rather too conservative, seeing that they are based on a combination of maximum effects, namely, symmetrical dead short-circuit occurring at maximum load and continuing with constant current over the actual period of break. The situation from the economic standpoint of the supply engineer is an important one, as it must lead in many cases to the provision of unnecessarily large mains.

The time factor in the breaking of the short-circuit current is of fundamental importance for upon it depends the heating effects produced in the cable and also, largely, the size of cable required to cope with the fault current. This time-element depends to some extent upon the type of switchgear and upon the method of protection adopted but in general the tripping of the switch is operated by a relay circuit.

With high-voltage distribution systems employing the normal type of overload protection, the relay is energised from a current transformer and has a time-setting device so that the delay in action varies inversely with the current, the minimum time corresponding to a short-circuit. The timing arrangements naturally depend upon the discrimination factor adopted and the position of the particular circuit-breaker in the system, as in grading the time delay for breaking the circuit each succeeding outward stage must be shorter than the preceding one. This enables each section of the distribution scheme to be self-protective, and is intended to prevent a failure on part of the system being transmitted back beyond its own control station and so cause disruption to an unnecessarily large area of the supply. This may be fairly easy to arrange for the usual sort of overloads where the delay required is comparatively long, but to combine this with adequate short-circuit protection for which rapid action is necessary is more difficult.

Quicker Breaking Essential

There are two distinct operations in breaking the circuit, the first is the functioning of the relay, which depends upon the time-setting, and the second is the tripping of the switch. Various types of switchgear may be incorporated in different parts of a system, and if their tripping times vary to an appreciable extent—as is most likely—much greater difficulty is experienced in obtaining proper discriminative protection. A circuit-breaker whose tripping alone occupies 0·3 to 0·4 sec. would make a prolonged short-circuit inevitable in the event of a fault occurring, when the minimum time delay of the relay has also to be taken into consideration. A much quicker break is essential for modern requirements if the duration of short-circuits is to be cut down to the minimum, thus economising in the size of cable.

The close attention of the switchgear manufacturers needs to be given to the requirements of the cable side of electrical installations in this respect. Naturally both sections are chiefly occupied with their own particular problems, but a little more co-operation might be advantageous to both sides and benefit the industry in general.

Education and Training

A Wider Conception Advocated

In this I.E.E. paper Dr. Fleming, the eminent industrial educationist, puts forward suggestions for a complete revision of methods of educating technicians and skilled craftsmen

THE education and training of engineers are critically reviewed in a lengthy paper presented by Dr. A. P. M. Fleming (Metropolitan - Vickers Electrical Co., Ltd.) to the INSTITUTION OF ELECTRICAL ENGINEERS in London on March 19th with the object of provoking open discussion so that suggestions arising therefrom may be taken into consideration by the Sub-Committee on Education, Training and Personnel when it submits its recommendations to the I.E.E. Post-war Planning Committee.

The common effort to create a body of skilled personnel adequate to enormous productive and operational war needs will, it is contended, be unsuited to long-term policy afterwards. Post-war problems will not be solved by individual effort, however well conceived, of particular sections of the industry, of educational authorities, or the universities; the separate efforts of all these must be linked together intimately in a national plan.

Industry as a whole has not accepted sufficient responsibility for the adequate education and training of its employees and, moreover, few of those firms which have made good internal provision for practical training have adequately recognised the need for part-time day release to ensure effectively continued technical education for their trainees, while educational authorities have also been greatly at fault. Quite outside these deficiencies the desirability for a broader conception of aims by both parties is becoming increasingly evident.

Dr. A. P. M. Fleming

If increasing specialisation for the technician and change from craft to mechanised operation for the artisan, accelerated by the exigencies of war, are imposed prematurely they will be detrimental to individual and industry as well as dangerous to the community. Not only must there exist beforehand an adequate background of general technical knowledge and experience, but also an appreciation of the purpose of the specialised activity in relation to the life and welfare of both the industry and community. It is of the greatest importance that every individual should be raised to the highest level of perception of which he is capable in each sphere.

After outlining the pre-war educational system in England and Wales (similar though not necessarily in the same form in Scotland) the paper briefly states the qualities and training required for nine grades of work, from semi-skilled repetition to managerial, and then suggests improvements.

The implication that each man should be helped to secure the type of employment in which he is best able to develop necessitates that so soon as it becomes clear, either during a period of probationary employment, or technical study, or subsequently, that a youth is unsuited to engineering he shall be transferred to more appropriate work, or course of study.

There is growing support for the arrangement whereby prospective engineering undergraduates spend a year in industry between school and the university, which is in every way advantageous, so long as reasonable provision is made for the continuance of scientific and mathematical studies. It seems to be the most effective means of self and guided selection, and the opportunity it affords for mental adjustment is of the greatest importance. Selection of those who proceed to full-time education in technical colleges, or universities, must not be limited by financial considerations, while choice of teachers requires as much attention as that of students. A technique of selection for the promotion of men within their own grade, or to others, cannot be formulated in any precise terms. So far as is possible *all* men should be kept under observation with a view to determining their outstanding characteristics functionally and, moreover, all the training facilities necessary for fully developing those characteristics should be utilised, not merely made available. Otherwise there can be no change from the existing system, which affords to technicians little opportunity of reaching the higher executive positions and sphere of management.

The junior technical type of school has been advantageous in one respect, but not in another. A large proportion of electrical trade apprentices from this source proceed so successfully with national certificate studies that in consequence (contrary to one of the original intentions of these schools) the equally important artisanship grade has not

been well furnished numerically (20 per cent.) from the same source. This fact raises an issue that will become acute as the number of such schools increases and the school-leaving age is raised, namely, that of creating for the highly mechanised positions physical and psychological attractions comparable with those of non-manual employment.

The introduction of properly sponsored national apprenticeship certificates might have a far-reaching effect, for it is the lack of adequate official recognition of the value of approved craft courses that is responsible for the entry upon the national certificate course of very many boys for whom the more abstract character of the instruction is unsuitable. Instead they ought rightly to be engaged on the workshop type of course. The serious aspect of the consequential considerable "death rate" is that few of those who withdraw find their way into craft courses; most go without any form of systematic instruction during the period when its continuance is vital.

University Aims

The fundamental difficulty is associated with the widespread restriction of the teaching to evening classes, when the time available is quite inadequate. The only solution would appear to be substitution, in whole or part, of part-time day instruction which would leave the evenings free (under careful guidance) for independent technical study and the fostering of more cultural interests.

Industry is by no means completely satisfied with the average product of university engineering schools. Overcrowding of their courses with formal technical instruction is detrimental to their educational value, and the degree of specialisation often permitted is highly undesirable. Students who are destined for high-grade scientific or technical work and those who are not should be separately treated; all would be better for a broader foundation.

The form of teaching is of even greater importance; the cast-iron curriculum, while reasonably sound in body, is dead in spirit. The university teacher's primary aims must be to awaken the critical faculty, to teach his students to assess evidence, to form reasoned judgment. Accumulation of factual knowledge at this stage is undesirable; students should be helped to acquire the habit of searching for such information for themselves.

There is a strong case for the revision of sessional time tables of university engineering schools. Such part of the long vacation as is spent in works, is well spent. If the major part of the remaining vacation periods were devoted to tutorial classes, preferably individual, conducted by the teaching staff, the general intensity of instruction in term time could be reduced.

Contrasted with the earlier demands for men capable, without any assistance from industry itself in respect of post-graduate training, of undertaking technical staff responsibility immediately after graduation, another school of thought prefers concentration on fundamental principles, aiming at the production of thinking, critical individuals, with technological introductions merely illustrative of principles. Without clarification in these respects undergraduate courses will continue to serve neither purpose effectively. Also, clearer distinction than has yet been made is called for between the respective functions of the universities and the technical colleges.

Making research a prominent part of engineering school work is a necessary corrective; it is required to afford scope and variety to the teachers, and enable them to maintain coherence and balance in their teaching.

Systematic post-graduate instruction is greatly needed. In a few cases it is obtainable within industrial concerns, but access is limited. It seems that formal instruction in such subjects as industrial management can be given with real profit only at the stage at which, having entered industry as an employee, the student is faced with them as practical realities directly affecting his welfare and progress to a position of responsibility. The fault is that too little advantage is taken of available courses; thirst for knowledge soon disappears (if it previously existed) once the attraction of a degree, title, or certificate, has been removed.

Apprenticeship and Craftsmen

While the value of practical experience is professionally admitted, national apprenticeship does not exist. Most schemes are devised to satisfy individual firms' requirements; some do much, others nothing, many provide training in name only. There is an obvious case in wartime for some nationally organised scheme, from which considerable benefit would accrue after the war.

The general introduction of such a system, combined with craft instruction and the award of national apprenticeship certificates on lines similar to those already in operation in miniature in the Coventry district would help to establish the status of craft employment and benefit industry immensely. Adequate supplies of repetition operatives might continue to be furnished by maintaining the present Ministry of Labour war-emergency (workshop) training centres.

To assist after-war reinstatement in industry of men returning from the fighting services, most companies normally conducting apprenticeship courses would probably be willing to extend their training facilities beyond their own requirements, though some Government grant or subsistence allowance would probably be required.

Industrial Installations

Discussion on Mr. L. C. Grant's Paper

SPECIFICATIONS caused most outspoken comment when the paper by Mr. L. C. Grant on "Electrical Industrial Installations" (to which reference was made last week) was discussed before the Installations Section of the Institution of Electrical Engineers in London on March 12th.

Mr. O. C. Waygood opened the debate with a deprecation of loose specifications. He said that it was not often easy to find suitable outside sites for substations; how many engineers would recommend roof substations after recent experiences? While the author had mentioned substations which had been saved by the installation of fire protection apparatus, he himself knew of a case in which the substation was saved because there was no fire protection apparatus, and that gave food for thought. Although drained cables had some advantages in certain cases, he had always used dry cables and had not been disappointed. There was a good deal to be said for steel or copper conduits.

The lower voltage for lighting mentioned by the author was attractive because of the reduction in the cost of electricity, but there would be heavier capital outlay and repairs and renewals would also go up. In present conditions he would not adopt a lower voltage for many installations spread over a large area because interchangeability of parts had to be considered. He did not think that stores were yet ready to accept fluorescent lighting, although it might be all right for factory work.

Increased Joint Resistance

Mr. H. W. Swann (Senior Electrical Inspector of Factories), commenting on the objection to certain forms of fire fighting installations, said that there had been a few cases of gassing due to the fire protection system, but very few fatal ones. He remarked that the author had not said very much about the resistance of joints in conduits, and recalled a case in which, after the concreting was completed, there was an increase of 10 per cent. in the joint resistance and it was necessary to draw in earth continuity wires.

With reference to busbar distribution, should the neutral bar of the busbar system be insulated or left bare? A reduction of lighting voltage was often the cheapest and best way of avoiding trouble where portable lights or tools were being used under wet conditions in shipyards, for instance, but in mills the distribution of the lighting load and the demands upon it made it inadvisable to use less than 230 V; 110 V would be justified for temporary installations in buildings under construction.

Mr. H. Marryat (Marryat & Place) said that installations of the type dealt with in the paper, and also when it was a question of spending public money on, say, ordnance factories, called for independent specifications, but in the ordinary rough and tumble of commercial business the matter could well be left to the contractor, for progress in installation work had originated almost entirely in the contractor's office. Regarding busbars for distribution, there were other systems than that mentioned which were fireproof and were capable of being connected direct to the terminals, had great flexibility and, further, could be built up in units and moved and altered from time to time. The underfloor duct system of enclosure had not been used very much and it was a pity the B.S.I. had missed the opportunity, when the specification was drawn up for duct-work, not to have designed it so that it would fall naturally into the floor structure which usually only came a very short way above the main steel joists.

Knob and Cleat Wiring

There was something to be said for 110 V, and it was the only hope of substantially reducing the cost of domestic wiring. The knob and cleat system was neat and very quick if the men were trained to the work, but the ordinary wireman was no good at it and took longer than with conduit work.

Mr. F. C. Raphael said that very few contractors, in quoting for a job in competition, would put in the amount of time necessary to prepare a thorough scheme allowing for all eventualities, but the practice still went on and consulting engineers were called in mostly to remedy the muddles thus created.

At 110 V there would be a little saving in watts per lumen, but had all-day transformer losses been taken into account by the author? Capital charges had been mentioned, but the actual wiring would cost very much more. In special cases the lower voltage might be used, but for the general run of factory buildings it paid to use the higher voltage.

Ducts could not be relied upon to remain waterproof, and it would be interesting to know how American rubber cables were standing up. The early experiences were not too good. They did not stand the British climate then, but might be better now. Knob and cleat wiring for 440 V was being used in factories, although nothing official had been published about it.

Mr. G. Smith (Ministry of Works and Buildings) said he was inclined to think that

lead-covered cable would come into greater use again owing to the shortage of rubber. Speaking of the author's plea for a margin for development, he said there were some factories which were very much "over-engined" and their installations would never be used to capacity. After agreeing with Mr. Swann on the question of lighting voltage, he advocated greater standardisation of high-rupturing-capacity fuses. His experience was that there was a tendency to employ the conduit system on the score of speed in erection.

Mr. A. L. Fielding (Kennedy & Donkin) said that he would go a little farther than the author and suggest 50 V. Such a system was in use in Switzerland some years ago and it involved a step-down transformer incorporated in every ceiling rose, or in the base of every table lamp. It was claimed to be safer and it also had the advantages of cheaper lamp costs and greater efficiency. Another claim for it was that the cost of the transformer was offset in about twelve months, but he had heard nothing more of that scheme. A successful installation in Sydney operated at 32 V, 50 cycles.

Mr. E. Jacobi (Troughton & Young) said that when more than 300 or 400 A had to be carried, bare copper was more economical than lead-covered cable. It was surprising that fibre-insulated cables had not come into greater use because they had all the advantages of paper-insulated cables and none of the disadvantages. What was the best wiring system depended on the type of building and the functions of the building. It might even be possible to use rubber hose filled with water to form channels in concrete, the water being subsequently drawn off.

Margin for Development

It was possible to make out a case for 50- or 24-V lamps, but if everybody gave expression to his individual ideas they would get right away from the purpose of standardisation. In his view, the most important thing in the paper was the reference to margin for development, but the opposite side of the picture was also important. There were industrial premises where the maximum demand did not approach 30 per cent. of the calculated demand. What was wanted was facilities for the usual extensions and alterations, rather than a margin for development. He believed that in a few years the line system of lighting would be so common that one would wonder why a point system of lighting had ever been tolerated. In conclusion, he pleaded for more co-operation between builders and installation engineers before a building was erected.

Mr. R. T. Lythall (Johnson & Phillips, Ltd.) said that nobody could prepare a specification for specialised equipment better than the manufacturer. It was impossible for any one man to prepare a specification so comprehensively as the author had suggested. Therefore he strongly disagreed with the suggestion that the manufacturer should not prepare a specification. The author did not lay sufficient stress on the desirability of greater space for the main substation equipment.

Mr. A. Morgan commented that conduit wiring was, of necessity, absolutely impossible under conditions of condensation. He referred to an American system of wiring which was a kind of trolley duct so that connections could be made anywhere and need not be a landlord's fixture.

Busbar Considerations

Mr. W. S. Sholl said that the cost of labour was rather great when using bare busbars for lighting because the bars must be supported at fairly short intervals and reasonably spaced. There was also the risk of the bars coming together, while lightning surges caused trouble. The system, however, was suitable in factories where there was no fine dust if only for its flexibility, and the fact that no drainage was necessary. He had seen some splendid work done on machines with low voltage under shock risk conditions, using small grouped circuits with standard 12-V automobile lamps.

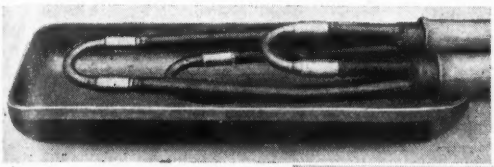
Mr. H. C. Cooper said that there was no flexibility in lead cables and the cost of installation was considerable. With regard to flooded conduits, cables were tested under flooded conditions and why should they not go on indefinitely under those conditions?

The author, in the course of a short reply to the discussion, said the knob and cleat system had come into prominence because it was in the specifications of at least two Government Departments and much of it had been put in. There had been controversy as to whether it was good or bad, whether it could be quickly installed, whether the average workman could do it and whether it would last; he was undecided about it himself. As to the saving in cost by the use of 110-V lighting, the £1,500 mentioned in the paper was the gross cost. He remembered the 50-V system at Zurich, but had not heard anything about it in this country. The suggestion of bare copper for heavy circuits introduced difficulties in mechanical protection. As to over-estimating demands, an installation was not designed for the connected load, but for the average load, taking into account diversity factor. The general use of the 5-ft. fluorescent tube was something which would burst upon us after the war, but the stroboscopic effect must be taken into account. As to specifications, he had no intention of specifying specialised productions, but the consulting engineer should be able to express an opinion about these; otherwise he should not be in existence.

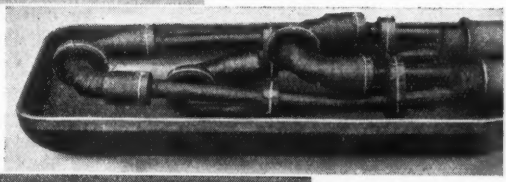
An Unusual Cable Joint

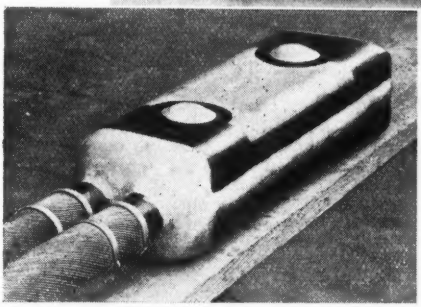
Useful for Air-Raid Repairs

PRESENT-DAY conditions often call for unusual methods of jointing cable. Circumstances frequently arise demanding the straight jointing together of two cables running adjacent and parallel to each other, so that the " ongoing " section of each cable is left dead. This led to the conclusion in Manchester that some standard method of dealing with this work was justified.



Such circumstances arise, for example, when a substation on an e.h.v. ring main is lost as a result of enemy action and it is necessary to complete the ring by jointing together the incoming and outgoing e.h.v. cables which are frequently laid parallel in the ground for a considerable distance. The conventional method is to expose a sufficient length of one cable, cut it, and turn it back on itself to such a position that it can be straight-jointed to the other cable. This requires a considerable amount of excavation which is frequently extremely difficult, due to pipes, other cables, etc., in the ground, and usually takes up a good many valuable hours.





The three stages of a joint made on two 0.3 sq. in. 11-kV paper insulated, lead covered and wire armoured cables

The " loop joint " illustrated eliminates all these disadvantages, being made by merely excavating a hole sufficiently large to joint in, suitably cutting both cables and jointing the cores of one to the cores of the other by means of a horse-shoe shaped ferrule. This method enables the whole job, excavating and jointing, to be done with a minimum of cost, labour, and more important still, during one full period of daylight.

The detailed design of the joint was governed largely by the fact that experience has shown that although first considerations are generally solely from the point of view of continuity of supply and therefore are probably considered temporary, a later consideration of the situation may dictate a change in substation site, for example, and thus the temporary work of to-day becomes the permanent work of to-morrow. It is therefore necessary that jointing should comply in all respects with the accepted practices of the undertaking concerned, and thus the work will be permanently dealt with.

In the joint shown in the photographs the ferrules were made of suitable section round copper rod bent to a horse-shoe shape and bored at the ends to form ferrules. The core cuts were stepped in order to permit easy phase selection, and the insulation was hand applied paper strip throughout. The joint was completed by enclosure in a lead box made up in two halves, each of which was previously formed by beating out a section of lead tubing and filling the box with compound.

Bristol Engineering Directory

THE Bristol Engineering Manufacturers' Association has just issued its directory for 1942. This includes an alphabetical list of firms in the city, a classified index of trades, and some useful electrical tables. It is obtainable from the Association, 104, Filton Avenue, Bristol, 7, at 9d. post free.

CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication Responsibility cannot be accepted for correspondents' opinions.

Advance Payment of Fixed Charges

I THINK your correspondent, Mr. L. A. Ferney, is in error in referring to fixed charges as an advance payment and seeking thereby to imply that the payment made was in the nature of a deposit, which it is not. The fixed portion of the two-part tariff payable in advance is part of the charge made by an undertaking, and although so payable it is regarded by most undertakings as accruing from day to day, and from day to day being used up. Accordingly the payment is not held by the local authority, J.E.A., or power company in perpetuity, or as long as the consumer chooses to stay on a two-part tariff.

Sections 27 and 71 of the Electric Lighting Clauses Act, 1899, refer to security given by consumers for payment of accounts. The fixed portion of the two-part tariff is not security for the payment of an account but the payment of an account itself.

*London, S.W.*1. LEX.

Is Mr. Ferney right in describing the two-part tariff payment in advance as a deposit? I think not. Is not "payment in advance" an item of the tariff itself?

*London, E.C.*1. J. J. LESSER.

High-Pressure Steam

WITH reference to the article by S. B. Jackson, together with the correspondence from H. Mahon and the author, in recent issues of your journal. "Calgonite" is a proprietary detergent, first manufactured in the United States and designed originally for use in dish-washing machines. The American product such as would be used at Twin Branch contains the alkalis caustic soda, sodium metasilicate and trisodium phosphate and, in addition, 40 per cent. Calgon (sodium metaphosphate). In the boiling-out process, it is serving the same purpose as the soda ash and trisodium phosphate used by Mr. Mahon, but the presence of the Calgon materially assists the detergent action of these alkalis by preventing the formation of certain insoluble compounds which tend to form a film on the surface being cleaned.

There does appear to be a considerable difference between the amounts of detergents used at Twin Branch and by Mr. Mahon, but some of the difference may be attributed to the fact that the proportion of water in Calgonite is small, whereas if Mr. Mahon used crystalline trisodium phosphate, he was employing a product containing some 55 per cent. of water.

In the treatment of boiler water under working conditions, Calgon and other phosphates are, of course, widely used, but here the intention is to precipitate the calcium compounds in the water in the form of a non-adherent sludge, as mentioned by Mr. Jackson. Before Calgon can do this it must be converted into orthophosphate, a reaction which takes place in the boiler. This must be carefully distinguished from the property utilised in the cleaning operation, where an excess of Calgon actually as the metaphosphate is necessary to prevent the appearance of insoluble compounds such as calcium carbonate or calcium soaps. It is this effect which allows of the addition of Calgon through boiler feed lines with less risk of precipitation than when the orthophosphates, such as tri- and di-sodium phosphate, are used.

KEITH PIERCY, LTD.
C. W. TOD,
Technical Service Department.

Oldbury.

Delay to Colliers

THERE is an interesting article in March 6th issue of *The Engineer* on "A Quicker 'Turn Round' for Ships" and I may be excused for bringing a few lines of this to the notice of many of your readers. It related to an important conference in the transport industry of the Port of London. In a special message the Prime Minister stressed the great importance of achieving a still quicker "turn round" of ships by ensuring that not one moment was lost in the loading or discharging of cargoes. Rules which hampered progress must be set aside.

This is as it should be, yet, in one of our largest power stations there is still an order that all colliers before unloading must be inspected by a competent engineer, a rough measurement taken in each hold of the height of coal, and before the ship sails an engineer has to inspect the ship again. In nearly every case it takes at least a quarter of an hour to find an available engineer, who, if it is raining or bitterly cold has to go to his office and find a coat, make his way to the ship, inspect each hold and certify that it is empty. At a conservative estimate a quarter of an hour to half an hour is lost on arrival and the same when the ship is empty or one hour per ship. Often three or four ships are inspected in one day, two arrivals and two departures, with a needless loss of two hours and more than that to the engineers concerned. This does not appear to be a very good way of securing a quicker "turn round."

Ilford. P. V. D.

PERSONAL and SOCIAL

News of Men and Women of the Industry

THE North-Western Centre of the Institution of Electrical Engineers held its annual luncheon on March 7th at the Engineers' Club, Manchester, when, in response to the toast of "Our Guests" proposed by Mr. H. Cobden Turner, Mr. G. H. Ince, Director-General of Man-Power at the Ministry of Labour and National Service, said that the only considerable reserve of labour still untapped was the large body of "unoccupied" women with domestic responsibilities. Wartime industries would now have to depend for additional labour almost entirely on the part-time services of such women, or on younger mobile women released from their present full-time jobs. It had been found in the Ministry's own offices that two women, each working half a day, were usually more productive than the full-time girl, and he urged Lancashire business men to give the country a lead in the part-time employment of women.

Sir Noel Ashbridge (president), in responding to the toast of the Institution, proposed by Engineer Rear-Admiral L. Robins, the Admiralty's representative on the North-West Regional Production Board, reviewed the wartime work of the Institution in finding a supply of technical personnel for the Forces, in helping the Ministry of Works and Buildings to draw up codes of professional practice, and in planning for post-war reconstruction.

Following on the retirement of **Mr. A. Cecil Livesey** from his position as joint managing director, upon his appointment as a director of the British Oxygen Co., Ltd., certain changes in function have been made in the board of Brookhirst Switchgear, Ltd. **Mr. John A. Hirst** remains chairman of the company and **Mr. E. Noel Humphreys** retires from the position of joint managing director and becomes deputy-chairman. **Messrs. J. O. Knowles, Allen Hirst** and **H. M. Goody** have been appointed joint managing directors, with **Mr. Gawthorne** as director and secretary. **Sir Walter St. D. Jenkins** has accepted a seat on the board.

The General Electric Co., Ltd., announces that **Capt. The Rt. Hon. David Margesson, P.C.**, M.C., has joined the board of the company.

Lt.-Col. J. T. C. Moore-Brabazon has joined the boards of Electric & Musical Industries, Ltd., and its operating companies.

Mr. R. A. Butler, President of the Board of Education, has succeeded Lord Hankey as chairman of the Scientific and Engineering Advisory Committees.

The Ministry of Supply announces that **Mr. A. M. Baer** has been appointed a Joint Controller of Non-Ferrous Metals in place of **Mr. J. C. Budd,** who has resigned on grounds of health.

Mr. H. B. Jenkins, A.M.Inst.C.E., A.M.I.E.E., who has been deputy borough electrical engineer at Bedford for forty years, is to retire on May 31st. The Corporation has reorganised the staff and promoted **Mr. A. Wainwright Evans,** M.Eng., A.M.I.E.E., A.M.I.Mech.E., to the post of chief assistant engineer. **Mr. S. A. Daines,** A.M.I.E.E., has been promoted to the position of meter and testing superintendent, and **Mr. H. Davies,** A.M.I.E.E., has been appointed consumers' and installation engineer.

The following new appointments have been made to fill vacancies:—**Mr. T. C. Ridings,** A.M.I.Mech.E., of Bradford, to the position of assistant power station superintendent, and **Mr. F. A. S. Walker,** A.M.I.E.E., of Oldham, to the position of charge engineer.

Mr. T. B. Nutter, A.M.I.E.E., whose appointment as borough electrical engineer of Burnley was briefly announced in our last issue, received his technical education at Burnley Technical Institute. He was apprenticed at the Burnley electricity works under the late Mr. W. R. Wright, and subsequently was appointed junior assistant. He became deputy electrical engineer in 1906. Mr. Nutter has taken an active interest in the development of the electricity undertaking, and the encouragement of domestic load, power consumption and metering.

Mr. T. B. Nutter

Consequent upon the retirement (reported last week) of Mr. James Gray from the position of chairman, the Electric Construction Co., Ltd., announces the following appointments:—Chairman, **Mr. G. W. Spencer Hawes,** O.B.E., M.I.E.E.; managing director, **Mr. W. M. Furniss. Mr. Walter Tonkinson,** who has been the company's chief engineer for many years, has been elected to fill the vacancy on the board.

Mr. J. Dean (Ferranti, Ltd.) has been nominated for re-election as chairman of the North-Western Students' Section of the Institution of Electrical Engineers. The annual meeting of the Section is to be held on April 11th.

Mr. H. H. Hill, chief electrician to the Metropolitan Water Board, is to retire on superannuation after forty years' service.

Mr. J. Bailey, head salesman for Brook Motors, Ltd., has been appointed hon. Area Adviser in Group 2, East and West Riding of Yorkshire, on the Directorate of Industrial Electrical Equipment, Ministry of Supply.

Obituary

Mr. J. M. M. Booth.—Friends of Mr. J. M. M. Booth, late of Billingham-on-Tees, will regret to hear of his death at Brighton on February 28th. Owing to the effects of war service (1914–18) Mr. Booth was compelled to retire, early in 1935, from the North-Eastern Electric Supply Co., at North Tees control room.

Herr R. Bosch.—It is reported that Herr Robert Bosch, founder and head of the Bosch magneto manufacturing concern, has died in

Stuttgart at the age of eighty-one. In his recent book, "The History of the Magneto" (see ELECTRICAL REVIEW, February 20th, p. 247) Mr. Frederick R. Sims recounts his association with Bosch early in this century and the developments which led to his breaking away from the rather uneasy partnership.

Mr. E. P. Grove.—Many readers will learn with regret of the death of Mr. E. P. Grove at Capetown on December 2nd.. Mr. Grove was educated at St. Edward's, Oxford, and King's College, London, and served an apprenticeship with Willans & Robinson. He joined the British Thomson-Houston Co. in 1895 and served as assistant engineer on the construction staff at the Bankside station of the City of London Co. From 1897 to 1898 Mr. Grove was occupied with the equipment for the Middlesbrough, Stockton and Thornaby tramways and was later transferred to Cork on similar work. He subsequently joined the Imperial Tramways Co. in charge of the equipment of the London United Tramways and Bristol Tramways.

Mr. Groves rejoined the B.T.H. about 1901 in charge of the construction department and was connected with the construction of the Central London Railway power station at Shepherd's Bush and later became chief engineer there. In 1913, he was appointed assistant engineer to Mr. Z. E. Knapp, chief engineer of the Underground system and was engaged for a few months in developing a scheme for railway extensions and power station enlargements.

Later in 1913 he joined Merz & McLellan and went to Australia to supervise the construction of the Melbourne suburban line electrification. He also reported on the proposed electrification of the New Zealand Government Railways. In 1925 Mr. Grove went to Capetown to carry out the construction of the Salt River power station and substations connected with the electrification of the suburban railways. After completing this work he joined the South African Electricity Supply Commission as engineer in charge of construction and supervised the extension to Salt River station and the station at Congella, Durban. In 1937 he was appointed resident electrical and mechanical engineer in charge of the Capetown City Council's new power station at Table Bay. This work kept him actively engaged until his retirement at the age of seventy-three in September, 1940.

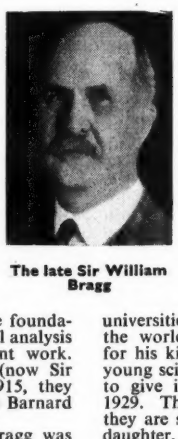
Mr. F. J. Selby.—The death occurred on March 5th of Mr. Francis James Selby, who was secretary of the National Physical Laboratory from 1918 to 1932.

Will.—**Mr. David Bennett,** of Haddow & Co., Ltd., electrical contractors, Glasgow, left personal estate in Great Britain of £6,319.

The late Sir William Bragg

WE regret to report the death of Sir William Bragg, the eminent scientist, on March 12th at the age of seventy-nine. William Henry Bragg was a native of Cumberland and was educated at King William's College, Isle of Man, and Trinity College, Cambridge. At the University he was Third Wrangler in the Mathematical Tripos in 1884 and soon after secured the position of professor of mathematics and physics at Adelaide University.

He remained at Adelaide for twenty-two years, during which time he married, and assisted his father-in-law, Sir Charles Todd, who was Australian Postmaster-General and Astronomer Royal, in radio investigations. It was while he was at Adelaide that he published his first paper on original work in radio-activity, which appeared in 1906 when he was about forty-four years of age, and this brought him into touch with the late Lord Rutherford, who was then in Canada.



The late Sir William Bragg

He left Australia in 1908 to become Cavendish Professor at Leeds University and in the succeeding years continued his X-ray studies, inventing the X-ray spectrometer and laying the foundations of the new science of X-ray crystal analysis which represented his most important work. In this he was assisted by his son (now Sir Lawrence Bragg) and together, in 1915, they were awarded the Nobel Prize and the Barnard Gold Medal of Columbia University.

From 1915 to 1923 Sir William Bragg was Quain Professor of Physics in the University of London. This included the period of the last war, when he was engaged upon anti-submarine research, being appointed consultant to the Admiralty in 1918 after working at Aberdour and Harwich. He was awarded the C.B.E. in 1917 and became K.B.E. in 1920. The Order of Merit was bestowed upon him in 1931.

In 1923 he was appointed Director of the Royal Institution, Fullerian Professor of Chemistry and Director of the Davy-Faraday Laboratory, and under his direction many valuable contributions were made to various branches of science. Sir William took the leading part in the organisation of the celebration of the Faraday Centenary in 1931. He was elected President of the Royal Society in 1935 and joined the Advisory Council for Industrial Research in 1937. In 1940 he became a member of Lord Hankey's Scientific Advisory Committee which was formed to advise the Lord President of the Council on scientific and technical developments likely to prove of importance to the war effort and to advise on the selection of individuals for particular lines of scientific inquiry.

Sir William was honoured by universities and scientific bodies in all parts of the world and he will long be remembered for his kindly disposition, particularly towards young scientists, to whom he was always willing to give inspiring advice. Lady Bragg died in 1929. Their second son was killed at Gallipoli; they are survived by Sir Lawrence Bragg and a daughter.

A memorial service was to be held yesterday (Thursday) at Westminster Abbey.

COMMERCE and INDUSTRY

Retailers' Supplies. War Damage Premium Lowered.

Fuel-Efficiency Training

AT the suggestion of the Fuel Efficiency Committee, the Mines Department, with the co-operation of the Board of Education, has organised a scheme of free training in fuel efficiency. Two courses have been arranged at each centre, the first comprising from six to twelve discussion lectures for management staff, and the second comprising six demonstrations for boiler-house attendants. In Manchester, St. Helens, Bolton, Birmingham, Coventry, Wolverhampton and Stoke-on-Trent the technical colleges have provided training facilities on the basis of a syllabus drawn up by the Fuel Efficiency Committee. As a result of the success achieved the scheme is to be extended to some thirty other centres.

Industrial consumers are notified individually by their Divisional Coal Officers when training facilities are available. The main points covered in the lectures include a survey of the national fuel position; properties and uses of fuels; principles of combustion, forced and natural draught, measuring instruments; steam-raising plant, care of fuel bed, clinkering, automatic stokers; heat transmission in boilers and industrial furnaces, refractories and insulators; sources of waste heat, their detection and stoppage or utilisation in local industries; industrial furnaces, construction and operation, including atmosphere control, improving efficiency during rebuilding; measurement of distribution of heat and heat flow.

Lectures and demonstrations are held in working hours, and employers have shown commendable readiness to release their staff to attend them.

Fair Distribution

Reference was recently made in the ELECTRICAL REVIEW to complaints that in certain areas retail distributors who have only entered the electrical industry since the war started have been able to obtain supplies of proprietary electrical goods while electrical retailers and contractors of many years' standing in the same towns have been unable to get them, the goods in question being in short supply due to war conditions.

The Electrical Fair Trading Council states that it feels that this is extremely unfair to established electrical traders, and it therefore recommends, in the interests of the legitimate trade, that manufacturers and wholesalers alike should give first preference in the distribution of available electrical supplies to those contractors and retailers who are known to have been fully established within the industry prior to the outbreak of war.

The Council says that it has also noted with concern the electrical apparatus of somewhat doubtful quality or origin that has recently found its way to the market. Having in mind that in the national interests only the very best use should be made of the limited raw materials that are available, the Council feels it desirable to advise all members of the trade that in their own interests they should discourage the sale or use of any apparatus which their technical experience tells them is shoddy, or inefficient in design, and likely to reflect discredit on the industry by constituting a danger to the user.

Russian Propaganda

Last week, at the headquarters of the Society for Cultural Relations Between the Peoples of the British Commonwealth and the U.S.S.R., at 98, Gower Street, London, W.C.1, we had an opportunity of seeing some very striking examples

A Russian war poster

of Russian war cartoons and posters. The horror and brutality of war are vividly shown in a coloured cartoon depicting a Russian mother and her baby murdered by the treachery of Hitler, and the need for constant vigilance against the enemy is emphasised in a poster showing a young sentry on guard before a factory turning out endless streams of tanks and munitions. The inscription under this poster, which we reproduce, says, "Guardians of our Republic we stand, defending the factories, bridges, roads, built by our own toil and sweat."

War Damage Act

The Board of Trade announced in September last that, with the approval of the Treasury, it had been decided that the premium payable under the business equipment scheme for the year ending September 30, 1942, would not exceed

30s. per cent. For the period of six months to March 31st the rate of premium was fixed at 15s. per cent. Having regard to present conditions and to the amount already paid by way of premium, the Board has, with the approval of the Treasury, decided to fix the rate of premium for the whole of the year to September 30th at 20s., so that the premium to be paid for the remaining six months will be 5s. per cent. This premium will be payable in one sum and one policy will be issued for the whole six months' period.

Second-hand Machine Tools

As from March 16th it is necessary to obtain a licence from the Machine Tool Control for the purchase of a used machine tool valued at more than £50. Used machine tools may be disposed of only to a licensed person or to an authorised dealer.

Further Export Control

Under a Board of Trade Order which becomes operative on March 17th, 1942, export control is extended to cover containers made from black plate and, in the case of certain destinations, to asbestos scrap and waste. The Order (S.R. & O. 1942 No. 313) also extends the existing control in respect of paper, paper board and certain articles manufactured therefrom.

Small Iron and Steel Orders

The Ministry of Works and Buildings draws attention to a number of points in connection with the procedure announced in November last for the issue of bulk iron and steel authorisations for small orders of manufactured articles required primarily for the building industry.

This "small orders" arrangement applies only to orders for manufactured articles (or fitted and finished goods) containing in all 1 cwt. or less of iron and steel combined in each order. It does not apply to iron and steel in the forms listed in the first schedule to the Control of Iron and Steel (No. 15) Order, *e.g.*, plain or rough castings, cast-iron pipes, steel tubes, bolts, nuts, rivets, etc. The "small lots" exemption under the No. 15 Order is unaltered and small quantity certificates must still be obtained from consumers in appropriate cases.

The manufactured articles for which the Ministry of Works and Buildings (Headquarters—A.S. 69) issues bulk authorisations of iron and steel to manufacturers for production for (*a*) small orders (all essential purposes other than exports), and/or (*b*) essential home civil trade (excluding work subject to licence under Regulation 56A) include cable racks and hangers; electric heaters of a fixed type (*i.e.*, incorporated in the structure of buildings); unit heaters and convectors; and ventilating and air-conditioning equipment (fixed type) other than that required for processing purposes.

Restriction of Steels

Last year's B.S.S. 970 listed 58 steels in what is known as the En series, which range was considered to be adequate for all the essential needs of the general engineering industry. This co-ordination of the production of steel in the British Isles has been taken a stage further by a "direction" (Iron and Steel Control) that in future all wrought and special alloy steels supplied by producers shall be made to a selected list of 44 of the 58 previously specified. Those varieties now available are named in B.S.S. 970A, which is obtainable for 9d. post free from the British Standards Institution, 28, Victoria Street, London, S.W.1.

Fluorescent Window Lighting

A scheme of window lighting employing "Sieray" fluorescent tubes and fittings has been planned by the Illuminating Engineers' Department of Siemens Electric Lamps & Supplies, Ltd., for Stagg & Russell, Ltd., in the booking hall at Leicester Square Underground station.

"Sieray" fluorescent window lighting at Leicester Square Station

Owing to limitations of space it was necessary to design specially narrow trough fittings for fixing to vertical glazing bars of the show windows, and special attention had to be paid to the contour of the reflectors in order to ensure correct light distribution and at the same time to prevent the light source from being too obtrusive. The trough reflectors measure only 3½ in. across, which means that in addition to the fittings being practically concealed, a considerable economy in material has resulted.

The installation originally comprised thirty 100-W gasfilled lamps, whereas the new installation has a loading of only 1.25 kW. Thus the annual saving is approximately 13,000 kWh.

In spite of this reduction in loading, the actual illumination in the windows is around 30 ft.-candles, as compared with 15 ft.-candles under the old installation.

As the AC supply available from the L.P.T.B. mains was at 33⅓ cycles special choke coils had to be supplied to give the correct impedance. The scheme was evolved in conjunction with Mr. A. W. Jervis, chief engineer of Stagg & Russell, Ltd., and the installation was carried out by his own staff.

Fatality

An inquest was held at Huddersfield recently on Mrs. Margaret Shaw (51), of Netherton, who was found dead in her home with her right arm caught in the flex of a vacuum cleaner which was still in operation, and grasping in her left hand a gas poker which was resting in the fire. The deputy borough electrical engineer (Mr. F. A. Ellis) said he examined the switch in the handle of the vacuum cleaner. One lead was badly bent and the rubber insulation punctured, exposing a part of the copper conductor about the size of a pin's head. Mrs. Shaw was standing on a wooden, well-carpeted floor, but she apparently picked up the metal gas poker which completed the electrical circuit. A verdict of "Accidental death" was recorded.

Clockwork Gears for Dial Gauges

A British Standard has recently been issued for the shape of teeth in gear wheels in clockwork mechanisms. In order to take advantage of this standard an amendment slip has been issued to the British Standard for dial gauges (B.S.S. 907) which adopts the standard form of gear teeth, given in B.S.S. 978, "Gears for Clockwork Mechanism," which also standardises the module for the gears and sizes of wheels for the mechanisms. Copies of the amendment No. 1 (to B.S. 907) may be had gratis on receipt of a stamped addressed envelope from the British Standards Institution, 28, Victoria Street, S.W.1. B.S.S. 907, "Dial Gauges for Linear Measurement" and B.S.S. 978, "Gears for Clockwork Mechanism", cost 2s. 3d. each, post free.

Change of Name

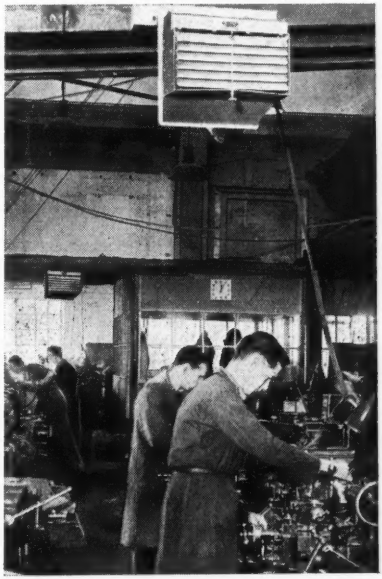
The London Electrical Co. (Sherborne Lane), Ltd., has changed its name to London Electrical Co. (Blackfriars), Ltd. The nominal capital has been increased by £4,000 in 4,000 ordinary shares beyond the registered capital of £16,000.

Cheerful Rationing

Greater use of the grill-boiler is advocated in the March issue of the Electrical Association for Women's "Cheerful Rationing" card, which also gives hints on soap saving, gardening, etc., as well as the usual cooking recipes.

Warming Cold Spots in Works

In the first Emergency Report of the Industrial Health Research Board a maximum temperature of 68 deg. F. is recommended where light work is being performed and 60 deg. where the work involves much muscular exertion. In many engineering establishments both conditions prevail in the same shop, but differential temperatures have been successfully obtained by the use of thermostatically-controlled local electric unit heaters, which can be installed without major structural alterations. The heaters can be operated separately and the fan alone can be used in warm weather. In the instance illustrated seven G.E.C. 15-kW unit heaters



G.E.C. unit heaters for providing local heating in a factory

were installed. Each unit consists of a sheet-steel casing housing a heater battery working at black heat and a "Genalex" fan element, which discharges the warmed air through adjustable louvres. The heaters are mounted on brackets on walls or stanchions about 8 ft. 6in from the ground. Similar arrangements have been adopted for augmenting existing general heating systems that have proved inadequate.

INFORMATION DEPARTMENT

GENERAL inquiries from readers relating to sources of electrical goods, makers' addresses, etc., are replied to by our Information Department through the post. Inquiries should be accompanied by a stamped addressed envelope.

Our extensive records enable us to reply to most queries, but occasionally we ask for our readers' assistance in tracing names and addresses not known to us. We should be glad to have information regarding the following:—

RUSSELL ELECTRO-MEDICAL, LTD.
COOKING EQUIPMENTS, LTD.
CRESTOLOY tools.

Electricity in America

Adapting Policy to Present Needs

STATISTICS covering the United States electric power industry during the past year have been compiled by the Edison Electric Institute. These indicate that the total installed generator capacity at December 31st, 1941, was 44,351,700 kW of which 30,995,400 kW was steam, 12,356,200 kW water power and 1,000,100 internal combustion engines. The total addition during the year was 2,854,346 kW and the estimated extensions for the current year total 3,654,475 kW and for 1943, 2,746,000 kW.

There was an increase of 15.9 per cent. in generation as compared with 1940, the total output being 168,000 million kWh of which fuel-burning plants accounted for 115,600 million (18.9 per cent. increase) and water-power undertakings 52,400 million (9.7 per cent. increase).

Sales of energy amounted to 140,340 million kWh, an increase of 18.3 per cent. Large lighting and power consumers were responsible for the largest consumption (76,247 million) and the greatest increase (28.0 per cent.). Under specific rural rates sales of energy rose by 18.0 per cent. to 2,350 million kWh.

Income Figures

The revenue did not increase in proportion to the energy sold; the total of $2,670 million represented a rise of only 9.4 per cent. It is noticed, however, that this did not apply in the case of rural supplies, the revenue from which ($63.5 million) was higher by 28.4 per cent. Large lighting and power consumers provided $761.3 million—an increase of 20.6 per cent.

There was an increase of 4.5 per cent. in the number of consumers which at December 31st was 31.6 million; the bulk of these (26 million) were residential or domestic who showed an increase of 4.1 per cent. A large rise in rural consumers (44.1 per cent.) did not greatly affect the total, for their number was only 2.4 million. There was actually a decrease (0.9 per cent.) in the number of large lighting and power consumers, who totalled 176,240.

Curves reproduced with the statistics show how, in spite of fluctuations in the cost of living, the course of the price of electricity has been steadily downward. The trend continued during 1941, although the cost of living figure moved sharply upward. The average price per kWh for domestic service was 3.73 cents, as compared with 3.84 cents in 1940 and 5.78 cents ten years ago. The average residential consumer used 986 kWh during the year against 952 kWh in 1940 and in ten years the use of electricity per residential customer has risen by 400 kWh, while the average price has fallen to 64 per cent. of the former figure.

Wartime Policy

During the war the commercial activities of the Edison Electric Institute are to be re-directed or intensified. One committee will study the use of electricity in industry, so as to speed up and increase production without waste and with improved quality. It will also study means of building up system load factors to reduce peaks and losses on utility systems.

It is proposed to foster a type of advertisement which will stress such use of present equipment as will ensure a minimum requirement of essential materials. Committees will encourage the repair of existing appliances and major equipment so that they may be kept in service.

The need for improved lighting arrangements in industry is realised and broader opportunities are given for committees to continue the study of lighting applications in industry to increase output, improve products and decrease labour as well as to conserve eyesight.

A home service committee will deal with kitchen rearrangement for labour-saving and meal planning to meet the increasing cost of living while maintaining the maximum nutritive values of food. A farm service committee will study methods and equipment which will give maximum increase in farm production, relief in farm labour requirements and minimise loss in perishable food products.

Committee studies are to be organised also along the lines of research and planning for the post-war period, when intensified sales efforts must be relied upon to cushion the economic shock at the termination of the defence programme.

Copper Consumption

In a memorandum submitted to the Federal authorities the Institute set out a detailed analysis of the copper used by American electrical utility companies for all purposes in 1941. It placed the total consumption at 129,000 tons: 34,000 tons for construction projects (additional generating capacity, substations and transmission lines) directly or indirectly occasioned by national defence loads; 43,000 tons for ordinary extensions to new consumers; and 52,000 tons for the maintenance and repair of existing systems. The major items were as

follows: Wires and cables, 99,400 tons; transformer windings, 17,200 tons; busbars, etc., 6,900 tons; and generators and other rotating equipment, 1,700 tons.

Functions of the Edison Institute

A leaderette in this issue refers to the varied work carried out by the Edison Electric Institute. It may be of interest to indicate the nature of the Institute's activities by giving a list of its committees; they are as follows:—Accident Prevention; Accounting Executive; Customers' Relations, Commercial Accounting and Collections; Depreciation; General Accounting; Plant Accounting and Records; Purchasing Stores and Transportation; Electrical Equipment; Hydraulic Power; Insurance; Membership; Prime Movers; Prize Awards; Rate Research; General Sales; Statistical; Transmission and Distribution; and Codes and Standards.

ELECTRICITY SUPPLY

Large Rate Contributions. *S.R. Electrification Policy.*

Barrow-in-Furness.—LOANS.—The Electricity Committee has obtained sanction to borrow for supply to the rural area and is seeking sanction to a loan for mains and services.

Hereford.—SHELTER HEATING PROPOSAL REJECTED.—The Emergency Committee reports that it is not thought desirable to install electric heating in the small communal shelters in the city owing to the expense and the difficulty of obtaining electricians to undertake the work. Also, it would afford fresh opportunities for destruction by malicious persons.

Liverpool.—LARGE RATE CONTRIBUTION.—The Electric Power and Lighting Committee has voted £40,000 from its surplus in aid of the general rate.

SHELTER TARIFF.—Terms agreed by the Civil Defence Emergency Committee for the heating and lighting of shelters are as follows:—Lighting, unmetered, 5s. per annum per 10-W, 12-V lamp; heating, unmetered, ½d. per kWh on the calculated wattage of the heaters installed; heaters controlled by time switches operating from 7 p.m. to 3 a.m. on hire at 2s. 6d. each per quarter.

London.—POPLAR.—The Electricity Committee recommends that in the post-war street lighting scheme, concrete posts shall be substituted for the present metal columns which can be released for scrap.

Perthshire.—STREET LIGHTING CHARGES.—The Grampian Electricity Supply Co. has informed the Western District Committee of the County Council that the charge for street lighting will be limited to 44½ per cent. of the payment made for the 1938-39 lighting season, subject to such kWh charges as may be payable in respect of any special wartime street lighting.

Salford.—WOMEN METER COLLECTORS.—Referring to the note on this subject in our last issue, Mr. L. Romero, the chief engineer and manager of the Electricity Department, points out that both his Department and the gas undertaking are controlled by the Light, Heat and Power Committee. The Electricity Department does not employ prepayment meters and so the women engaged by the Committee will collect only from gas prepayment meters.

Southport.—SUBSTATION EQUIPMENT. — New pillars, tanks, transformers and switchgear are to be installed in various substations at a cost of £3,537 and in two substations switchgear is to be replaced at an estimated cost of £1,305.

Sunderland.—CABLE AND SWITCHGEAR.—The Corporation Electricity Committee is to spend £7,500 out of revenue for the laying of cable and provision of additional switchgear.

Overseas

Chile.—HYDRO-ELECTRIC SCHEME.—According to a report by the United States Department of Commerce work began last November in Chile on the Sauzal hydro-electric project which will cost about £15,000,000. The maximum capacity will be 99,000 HP, and an output of 392,000,000 kWh is expected. The regions around Santiago, Valparaiso and Aconcagua will be served, and when the station is completed it will supply power for the electrification of the Santiago-Cartagena and Santiago-Colchagua sections of the State Railways, as well as new factories in the region.

TRANSPORT

Newcastle-on-Tyne.—RATE RELIEF.—Despite a protest by the Chairman of the Transport and Electricity Committee (Ald. R. Mayne) the City Council has agreed to take £20,000 from the funds of the undertaking for the relief of the general rates. Ald. Mayne hinted at the possibility of future nationalisation of transport, when profits might be allocated from a "pool" according to the value of the undertakings. His recommendation that the undertaking's funds should be left intact was rejected by 29 votes to 18.

Southern Railway.—ELECTRIC LOCOMOTIVE DEVELOPMENT.—The recent completion of the first of two new electric locomotives able to operate on the third-rail, low-voltage system was referred to by Mr. R. Holland Martin (chairman) at the company's annual meeting last week as one of the most interesting events of the past year from a railway point of view. He pointed out that up to the present the whole of their electric rolling stock had consisted of multiple-unit trains. They had retained steam engines to work goods trains and passenger trains going beyond the electrified area. The development of the mercury-arc rectifier in place of the rotary convertor rendered economic extensions with the third rail beyond the suburban area (for which the third-rail system

was particularly suited) to Brighton, Hastings and Portsmouth, but they had always realised that the full benefit of electric traction could only be secured if all traffic over electrified lines could be worked electrically. This involved the design of an electric locomotive which would work satisfactorily over the gaps in the conductor inherent in the third-rail system. Their chief electrical engineer, Mr. Alfred Raworth, had shown marked ability in solving this difficult problem, and the first locomotives—the mechanical parts of which were constructed to the design of Mr. Bulleid, had been successfully tested on 750-ton passenger trains and 1,000-ton freight trains. The two engines had reached an advanced stage at the outbreak of war and it was thought wise to proceed to completion as and when opportunity offered. For the immediate future each electric locomotive would help the war effort by releasing one—or more—steam engines for use elsewhere. For the more distant and peaceful future they could now review further electrification of the system from a new and promising angle.

E.D.A. and the War

Speeches at Area Luncheons

THE national organisation of mutual aid groups to enable electricity authorities to maintain a supply of electricity, despite enemy action, is a notable piece of organisation by the supply undertakings throughout the country. In this matter, the Electrical Development Association has acted as a co-ordinating body and, through its area offices as well as at headquarters, provided the necessary secretariat for a scheme which has been of the utmost value. This scheme was among many activities reviewed in a comprehensive address by Mr. J. E. Nelson (Mersey Power Co.), retiring chairman of the N.W. England and N. Wales Area Committee of E.D.A., in responding to the toast of "The Association," proposed by Mr. H. Cobden Turner (chairman, I.E.E. North-Western Centre) on March 12th at the Engineers' Club, Manchester, where the annual luncheon and general meeting took place.

Mr. Nelson said that the greatest continuous effort had been in connection with the food campaign; E.D.A. had a national scheme ready when Lord Woolton's campaign started in 1940 and hundreds of cookery demonstrations were immediately begun. The Association had co-operated with the Government in urging and practising fuel economy and, with gas interests, was assisting to plan official propaganda to make the public realise the importance of voluntary economy, otherwise compulsion would come. He deplored the reasons for the coal shortage. Looking ahead, he foreshadowed the possibilities for the expansion of electrical services in country areas.

Mr. Cobden Turner remarked that in visiting factories he had been struck by the amount of old-fashioned machinery, plant and general equipment still employed and he advocated the establishment of a society aiming at more up-to-date installations. He commended E.D.A.'s movement for better lighting.

The toast of "The Guests" was submitted by Mr. J. Harwood Lumsden, chief engineer of the Stalybridge, Hyde, Mossley and Dukinfield Transport and Electricity Board, who was elected chairman of the Area Committee at the general meeting in the afternoon. The reply was made by Alderman A. Critchley, M.P., chairman of the Liverpool Electric Power and Lighting Committee.

At a luncheon held at Leeds by the Mid-East England Area of E.D.A., Mr. A. C. Cramb, director and secretary, referred to the possibility of electricity supplies being rationed. He said that the industry rightly felt that a rationing order for electricity and gas—particularly electricity—would be a very difficult matter. Following representations, it had been announced that rationing would be avoided if possible, but the Government had to be prepared for all emergencies. With regard to the repair of electric kettles and hot-plates, the position was becoming rather serious. The material used for the essential portion of much electrical apparatus was now required for the war effort, and there had been great difficulty in securing the completion of repairs. For a long time the Association had been worrying Government Departments on this question of electrical apparatus, and he was glad to say that the output of heating elements for kettles had improved a good deal and was still improving.

Mr. R. O. Seville, chairman of the Area Executive Committee, presided, and a civic welcome was extended to the members by the Lord Mayor (Alderman Hyman Morris).

New Mechanical Corps

ONE of the recommendations of the Beveridge Committee on Skilled Men in the Services in its second report was that the War Office should set up a Corps of Mechanical Engineers. In its comments on the report the War Office expressed the view that it was not an easy matter to establish such a corps in the middle of a war but that the matter had been referred to three senior members of the War Office staff for their study.

In the House of Commons last week, less than a month after the appearance of the report, the Financial Secretary to the War Office (Mr. D. Sandys) stated that it had been decided to bring together the greater part of the Army's engineering maintenance services and to form them into a new, separate corps. The principal components of the new corps would be the entire engineering side of the Royal Army Ordnance Corps, all the maintenance personnel of the Royal Army Service Corps, with the exception of formation workshop platoons and independent companies, and a large part of the mechanical maintenance personnel of the Royal Engineers.

These far-reaching measures of reorganisation would necessarily entail extensive administrative changes and large-scale transfers of men. The formation of the new corps was therefore bound to take a certain amount of time but there would be no avoidable delay.

FINANCIAL SECTION

Company News. Stock Exchange Activities.

Reports and Dividends

Philips Incandescent Lamp Co.—A *Reuter* message from Curacao (D.W.I.) states that the report of the company for the year to April announces that before the invasion the principal assets in the British Empire and Western Hemisphere were, as a precaution, transferred to British and American trusts, of which remaining bona fide shareholders became beneficiaries. Data in respect of the occupied territories being unavailable, the drawing up of a balance sheet is impossible, and in its place a statement is submitted of assets and liabilities in unoccupied territory. This shows capital amounting to 10.3 million guilders, including a profit of 45,210 guilders. The American Trust consolidated balance sheet shows trust capital of $17,876,324. A loss of $765,033 was incurred chiefly as the result of depreciation of security holdings. The British Trust consolidated balance sheet shows trust capital of £3,112,794, with a profit of £316,322. The management states that the measures taken to compensate for the loss of Eindhoven as a supply centre and to maintain the company's marketing position have to a certain extent been successful, thanks to the loyal co-operation of American enterprises, but it views with concern the increasing scarcity of raw materials.

The British Power & Ligbt Corporation, Ltd., in its accounts for 1941, shows dividends, interest, etc., totalling £335,124, as compared with £271,390 for 1940. After deducting directors' fees and expenses the profit is £326,803 (against £263,293), less tax of £201,500. The ordinary dividend is maintained at 6 per cent. for the year, and £118,889 is carried forward (against £99,111 brought in).

In his speech which has been circulated with the report and accounts, Mr. C. E. Benson (chairman) says that the increased business is reflected in the larger revenue shown in the consolidated statement of earnings from the sale of energy, and also as a natural consequence in the cost of energy. While the margin between revenue from the sale of energy and the cost of generation and purchase has increased by 12 per cent., operating and management expenses have increased by less than 3 per cent. Although the matter of war damage contribution is still not finally determined, they are a good deal nearer to decision on this point than a year ago.

The Lancashire Electric Light & Power Co., Ltd., held its annual meeting on March 11th, when Sir Joseph Nall (chairman), who presided, said that notwithstanding the fact that they were engaged and scheduled in an essential industry, no less than 25 per cent. of their regular employees had joined the Forces. Their demonstration showrooms and depleted commercial staffs were at the disposal of the Ministry of Food for instructing the public in wartime cooking. The technical staffs were mobilised to help their neighbours in case of emergency. While concentrating on giving the best possible service required under war conditions, they were giving careful thought to the problems which would undoubtedly arise when peace was once more restored. It was essential to the post-war re-establishment of British industry that company-owned public utilities should in due course be enabled to resume their normal activity and progress.

The Scottish Power Co. reports trading profits for 1941 of undertakings owned and operated, together with miscellaneous receipts, of £977,046, as compared with £811,594 for 1940, and after provision of tax on earnings, £642,265 (against £634,399). Of this aggregate £302,030 is placed to depreciation and reserves or carried forward in the accounts of the operating companies, leaving £340,235 available. After deducting general expenses, tax, etc., the net profit of the parent company is £283,008 (against £320,979). Reserve again receives £35,000 and it is proposed to pay a final ordinary dividend of 5½ per cent., making 8 per cent. for the year (same) and to carry forward £12,918 (against £12,910).

British Insulated Cables, Ltd., reports profits for 1941 of £810,385, as compared with £786,232 for 1940. From this the following allocations have been made: depreciation, £247,324; directors' fees and works committee remuneration, £15,713; war contingencies, £100,000. It is proposed to pay a final ordinary dividend of 10 per cent., less tax. With a cash bonus of 5 per cent. this makes a total distribution of 20 per cent., less tax, for the year, the same as for 1940. The balance carried forward is £478,547 (against £488,699 brought in).

The British Thomson-Houston Co. Ltd., announces profits for 1941 of £559,776, after providing for taxation, as compared with £572,516 for the previous year. Depreciation receives £229,667, and general reserve £100,000. The ordinary dividend for the year is maintained at 7 per cent., less tax, and £217,413 is carried forward (against £196,310 brought in).

Associated Electrical Industries, Ltd., is again paying an ordinary dividend for 1941 of 10 per cent.

The London Passenger Transport Board reports a net revenue for 1941 of £4,842,307, an increase of £30,326 as compared with 1940. The decrease of £8,577 in the available net revenue (£4,844,659) is due to the decline from £41,255 to £2,352 in the profit from investment realisations and the amount brought in from the "C" stock interest fund. Interest upon the prior charge stocks requires £4,080,447, leaving for the service of the "C" stock a sum of £764,212. As already announced, it is proposed to make a final payment of 2⅛ per cent. on the "C" stock, making a total for the year of 2⅞ per cent. The undistributed balance of £25,371 has been carried to the London Transport "C" stock interest fund. A sum of £2,765,000 has been charged by way of provision for renewal and carried to renewal reserve. The maintenance reserve receives £35,000, and a sum of £53,577 has been spent from this reserve. The balance of £91,999 brought forward from the previous year has thus been

reduced to £73,422, against which there were authorised commitments of £120,857.

Under the financial arrangements with the Government a trust fund has been formed in which a sum equivalent to that part of the standard allowance for maintenance which is not expended currently in meeting actual expenditure on maintenance and renewal is to be paid in the joint names of nominees of the Government and the Board.

Discussions are to take place with the Government in regard to war damage contributions, and in the meantime no specific provision for the ultimate liability of the Board for war damage has been made.

Engineering Components, Ltd., reports that the net profits earned by its subsidiary companies for 1941, after deducting depreciation, but before making provision for taxes, were £120,659, as compared with £128,534 for the preceding year. The net revenue of the parent company is £19,553 (against £22,357), and it is proposed to pay a final ordinary dividend of 15 per cent., making 25 per cent. for the year (unchanged). The balance carried forward is £9,618 (against £8,024 brought in).

The Automatic Telephone & Electric Co., Ltd., reports a profit for 1941 of £261,548 as compared with £238,052 in the previous year. Directors' fees require £3,052 (same), depreciation £50,163 (£50,333), War Damage Act premiums £24,997 (nil) and war contingencies and taxation reserve £60,000 (£40,000). The final dividend on the ordinary stock is 7 per cent., again making 10 per cent. for the year, in addition to which a cash bonus of 2½ per cent. (same) is paid. A sum of £146,211 is carried forward against £167,422 brought in.

Lancashire Dynamo & Crypto, Ltd., states that the profit available for distribution for 1941 is approximately £111,000, after charging E.P.T. and income tax, as compared with £105,035 for 1940. It is proposed to pay a final dividend of 10 per cent. and a bonus of 5 per cent., maintaining the distribution for the year at 20 cent., less tax.

The Midland Electric Manufacturing Co., Ltd., reports a profit for 1941 of £42,022, as compared with £45,441 for 1940. It is proposed to pay a first and final dividend of 10 per cent. and a cash bonus of 15 per cent. (same).

Venner Time Switches, Ltd., are paying two years' full dividend on the 8 per cent. cumulative preference shares, bringing payment up to March 31st, 1942.

Whitehall Electric Investments, Ltd., is paying a dividend of 1¼ per cent. on the 7½ per cent. cumulative preference stock, representing the balance for the half-year ended September 30th, 1941, and 1¼ per cent. in respect of the half-year to March 31st next.

The South Metropolitan Electric Light & Power Co., Ltd., has declared a first and final dividend of 7 per cent., less tax, for 1941. The dividends for the four previous years were as follows:—1937, 9 per cent.; 1938, 9 per cent.; 1939, £8 13s. 1d. per cent.; 1940, 5 per cent.

Waste Heat and Gas Electrical Generating Stations, Ltd., is paying a final dividend of 5½ per cent., making 8 per cent. for the year (unchanged).

The Metropolitan Electric Supply Co., Ltd., has announced a final ordinary dividend of 5 per cent., making 8 per cent. for the year (same).

The Midland Electric Corporation for Power Distribution, Ltd., is paying a final dividend of 6 per cent., again making 9 per cent. for the year.

Ericsson Telephones, Ltd., is again paying a final dividend of 12 per cent., free of tax, but the bonus is reduced from 5 to 3 per cent., making the year's total 20 per cent. free of tax, against 22 per cent.

The Watford Electric & Manufacturing Co., Ltd., has announced a second interim dividend of 10 per cent.

Companies' Returns

Statements of Capital

Sudan Light & Power Co., Ltd.—Capital, £500,000 in 406,000 ordinary and 94,000 preference shares of £1. Return dated November 5th. 406,000 ordinary and 52,000 preference shares taken up. £458,000 paid. Mortgages and charges: £400,000.

Hanovia, Ltd.—Capital, £25,000 in £1 shares. Return dated December 12th. All shares taken up. £20,500 paid. £4,500 considered as paid. Mortgages and charges: Nil.

F. H. Sowden, Ltd.—Capital, £1,000 in £1 shares. Return dated January 14th, 1940 (filed February 6th, 1942). 550 shares taken up. £550 considered as paid. Mortgages and charges: Nil.

A. V. Caldwell, Ltd.—Capital, £1,000 in 1,000 shares of £1 each. Return dated January 14th. 1,000 shares taken up. £1,000 paid. Mortgages and charges: Nil.

Bate Electrical Co., Ltd.—Capital, £2,000 in £1 shares. Return dated June 11th, 1941 (filed January 17th, 1942). All shares taken up, £898 paid. £1,102 considered as paid. Mortgages and charges: Nil.

Bush Radio, Ltd.—Capital, £80,000 in 320,000 shares of £5 each. Return dated January 5th. All shares taken up. £80,000 paid. Mortgages and charges: £47,426 14s. 2d.

Mortgages and Charges

Engineering & Lighting Equipment Co., Ltd.—Mortgage on freehold land and premises, with machinery and fixtures and general assets, etc., dated February 28, 1942, to secure all moneys due or to become due from the company to Midland Bank, Ltd.

Electro Methods, Ltd.—Charge on all debts and money payable to the company mentioned in a schedule to the charge, dated February 12th, 1942, to secure all moneys due or to become due from the company to Barclays Bank, Ltd.

Liquidations

Voltalite, Ltd. — Winding-up voluntarily. Liquidator, Mr. F. S. Burman, 37, Brown Street, Manchester, 2.

Page & Miles, Ltd.—Meeting April 7th at 11–12, Finsbury Square, London, E.C.2 to receive an account of the winding-up by the liquidator, Mr. N. W. Osborne.

STOCKS AND SHARES

TUESDAY EVENING.

STOCK Exchange business continues to be controlled largely by the nature of the war news. Of late, the developments in the Pacific have been anything but satisfactory to the cause of the Allies, with the result that, from the merely Stock Exchange point of view, business has been restrained and prices, generally speaking, have been listless. The diversion of enormous amounts of money into various forms of war borrowing by warships weeks, makes a contributory cause to the reasons for quietude in most Stock Exchange departments.

Budget hints are becoming a little more definite; these, taken in conjunction with the continual increase in restrictive legislation applied to commodities, etc., serve as handicaps to investment and speculative enterprise. Quotations are remarkably well held, considering the circumstances.

London Transport Stock

The accounts of the London Passenger Transport Board explain why it is that the dividend on the " C " stock has been reduced from the 3 per cent. paid for 1939–40, to $2\frac{7}{8}$ per cent. in respect of last year. The reduction of half-a-crown per cent. in the dividend probably seems to the holder of the stock too negligible a change to have been worth while making, but the accounts show that there was a decline in profit from investment realisations. This, added to the lesser amount brought in from the " C " stock interest fund, made the trifling reduction necessary. The figures suggest that with reasonably good fortune, the stock should receive 3 per cent. in respect of the current year. The price is unchanged at 39 middle. Southern Railway 5 per cent. preference and preferred ordinary are stronger on the week. A rise of $\frac{1}{16}$ lifted Thomas Tilling shares to 48s. 9d.

Cable and Wireless

After falling to 47, the price of Cable and Wireless ordinary stock found its slump arrested by a few supporting orders which had the effect of reviving it to the neighbourhood of 50. At the same time, the $5\frac{1}{2}$ per cent. preference stock, which had been down to $87\frac{1}{2}$, recqvered to 90, at which latter price the yield on the money comes to $6\frac{1}{8}$ per cent. As mentioned recently, the Cable and Wireless financial year ends with December ; and, according to the figures given in the accounts for 1940–41, there should be no difficulty in maintaining the dividend on the $5\frac{1}{2}$ per cent. preference stock; nor, on the figures so far as they are known, in repeating the 4 per cent. dividend paid on the ordinary stock since 1937 inclusive. It is, of course, quite possible that the directors may prefer to adopt a cautious attitude and keep the money in hand rather than distribute anything this time to the ordinary stockholders. Doubts on this point will be resolved early in June. As a speculative post-war investment, the ordinary stock should be worth, at any rate, something between 40 and 50, whether it receives any further wartime dividend or not; the $5\frac{1}{2}$ per cent. preference stock does not look expensive at 90.

Dividend Announcements

Every business day adds its quota to the number of dividend announcements that follow closely the figures of the previous year. British Power & Light, Metropolitan Electric, Midland Counties Electric, Scottish Power, are but four out of the number of electricity supply undertakings which are paying similar dividends to those of a year ago. The South Metropolitan Electric Light & Power has raised the dividend on its ordinary shares from 5 to 7 per cent. These are held mainly by the County of London Electric Supply Co. There is no market in them.

Under the Government ban, the companies are not allowed to publish figures relating to the progress of their undertakings, but it is taken for granted that earnings have continued throughout 1941 on a satisfactory scale, while the absence of air-raids has enabled business to go on without interruption. Prices show little change. Where dividend deductions from quotations have taken place, the former have mostly been recovered. A minor feature is the continued demand for preference shares, a number of the 6 per cents. being now on a 31s. level, giving a yield at that price of no more than £3 17s. 5d. per cent. on the money.

London Associated

In reducing its dividend from $4\frac{1}{2}$ per cent. to 4 per cent. for the year, London Associated Electricity Undertakings, Ltd., fulfilled the previous anticipation that the dividend would again be cut. The initial dividend in 1935, and in each of the three succeeding years, was 7 per cent.; it was lowered to $5\frac{1}{2}$ per cent. in 1939, to $4\frac{1}{2}$ per cent. in 1940, and now to 4 per cent. The price of the shares remains unchanged at 18s. 9d.

Lancashire Dynamo

Lancashire Dynamo & Crypto, Ltd., again makes up its final dividend and bonus to a total of 20 per cent. for the year. The available profit of £111,000 is about £5,000 more than that of the previous twelvemonth. Apart from its main business of manufacturing electrical plant, etc., it is interested in several similar undertakings concerned with the manufacture of cinema rectifiers, testing sets, transformers and switchgear. The

(*Concluded on page* 385)

ELECTRICAL INVESTMENTS

Prices, Dividends and Yields

Company	Dividend 1939–40	Dividend 1940–41	Middle Price Mar. 16	Rise or Fall	Yield £ s. d.
Home Electricity Companies					
Bournemouth and Poole	15	12½	56/3	..	4 9 0
British Power and Light	6	6	27/6xd	..	4 7 3
City of London	7	7	27/6	..	5 1 9
Clyde Valley	8	8	39/6	..	4 1 0
County of London	8	8	37/6xd	+6d.	4 5 6
Edmundson's:					
7% Pref.	7	7	33/9	..	4 3 0
Ord.	6	6	28/6	..	4 4 3
Elec. Dis. Yorkshire	9	9	42/6	+6d.	4 4 9
Elec. Fin. and Securities	12½	12½	46/3	..	5 8 2
Elec. Supply Corporation	11½	10	45/–	..	4 9 0
Isle of Thanet	2	Nil	10,–	..	—
Lancs. Light and Power	7½	7½	34/6xd.	..	4 7 0
Llanelly Elec.	5½	5½	22/–xd	–6d.	5 0 0
Lond.Assoc.Electric	4½	4	18/9	..	4 5 4
London Electric	6	6	25/9	..	5 13 3
London Power Red. Deb.	5	5	103½	..	4 16 7
Metropolitan E.S.	8	8	37/–	..	4 6 6
Midland Counties	8	8	38/9	..	4 2 0
Mid. Elec. Power	9	9	41/3	..	4 7 4
Newcastle Elec.	7	7	27/6xd	+9d.	5 1 10
North Eastern Elec.:					
Ordinary	7	7	30/9	..	4 11 1
7% Pref.	7	7	34/–	..	4 2 4
Northampton	10	10	46/3	..	4 6 7
Notting Hill 6% Pref. (£10)	6	6	8½	..	—
Northmet Power:					
Ordinary	7	7	35 9xd	+6d.	3 18 4
6% Pref.	6	6	31/6	+6d.	3 16 2
Richmond Elec.	6	6	23/9	..	5 1 1
Scottish Power	8	8	38/9	..	4 2 9
Southern Areas	5	5	19/6	..	5 2 8
South London	7	7	27/–	..	5 3 8
West Devon	5	5	21/3	..	4 14 1
West Glos.	4½	4½	21/3	..	4 4 8
Yorkshire Elec.	8	8	39/6	..	4 1 0
Overseas Electricity Companies					
Atlas Elec.	Nil	Nil	4/–	–3d.	—
Calcutta Elec.	8*	7*	20/–	–1/16	—
Cawnpore Elec.	10	10	25/–	–¼	8 0 0
East African Power	7	7	27/–	..	5 3 8
Jerusalem Elec.	7	5	18/9	..	5 6 8
Kalgoorlie (10/–)	7½	7½	9/6	..	7 12 10
Madras Elec.	6*	4*	15/–	–⅛	5 6 8
Montreal Power	1½	1½	23	..	6 10 5
Palestine Elec. "A"	Nil	Nil	18/9	..	—
Perak Hydro-elec.	6	7	5/–	–1/16	—
Shawinigan Power	83cts.	90cts.	14½	..	—
Tokyo Elec. 6%	6	6	12½	..	—
Victoria Falls Power	15	15	73/9	–1/16	4 1 4
Whitehall Inv. Pref.	7½	7½	16/3	..	9 4 8

Company	Dividend 1939–40	Dividend 1940–41	Middle Price Mar. 16	Rise or Fall	Yield £ s. d.
Public Boards					
Central Electricity:					
1950-70	5	5	110	..	4 11 1
1955-75	5	5	113	..	4 8 6
1951-73	4½	4½	109	..	4 2 7
1963-93	3½	3½	103	..	3 8 0
1974-94	3½	3½	99	..	3 5 8
London Elec. Trans. Ltd.	2½	2½	94	..	2 13 2
London & Home Counties 1955-75	4½	4½	110	..	4 1 10
Lond. Pass. Trans.:					
A	4½	4½	120½	..	3 14 8
B	5	5	119½	..	4 3 8
C	3	2½	39	..	7 7 5
West Midlands J.E.A. 1948-68	5	5	110	..	4 11 0
Telegraph and Telephone					
Anglo.-Am. Tel.:					
Pref.	6	6	108½	..	5 10 8
Def.	1½	1½	25	..	6 0 0
Anglo-Portuguese	8	8	15/–	..	10 13 4
Cable & Wireless:					
5½ Pref.	5½	5½	90	–3½	6 2 3
Ord.	4	4	50	–4	8 0 0
Canadian Marconi $1	Nil	4cts.	5/6	..	3 0 0
Globe Tel. & Tel.:					
Ord.	8½*	8½*	26/3	..	—
Pref.	6	6	26/3	..	4 11 4
Great Northern Tel.:					
(£10)	20	20	14½	..	—
Inter Tel. & Tel.	Nil	Nil	3	..	—
Marconi-Marine	7½	7½	28/9	..	5 4 4
Oriental Tel. Ord.	11½*	16	47/6	..	6 14 9
Telephone Props.	6	6	10/–	..	12 0 0
Tele. Rentals (5/-)	10	10	9/–	..	5 11 1
Traction and Transport					
Anglo. Arg. Trans.:					
First Pref. (£5)	Nil	Nil	5/–	..	—
4% Inc.	Nil	Nil	9½	..	—
Brit. Elec. Traction:					
Def. Ord.	45	45	915	..	4 18 5
Pref. Ord.	8	8	170	..	4 14 2
Bristol Trams	8	10	45/–	..	4 9 0
Brazil Traction	$1	50c.	13½	..	—
Calcutta Trams	8	5½	12/6	..	8 16 0
Cape Elec. Trams.	5	5	19/–	..	5 5 3
Lancs Transport	10	10	45/–	..	4 9 0
Mexican Light:					
1st Bonds	5	5	75½	..	6 12 5
Rio 5% Bonds	5	5	97¼	..	5 4 8
Southern Rly.:					
5% Prefd.	5	5	63½	+1	7 17 6
5% Pref.	5	5	107½	+½	4 13 0
T. Tilling	10	10	48/9	+1/16	4 2 2
Tilling & B.A.	7*	6½*	52/6	..	2 9 6
West Riding	10	10	39/–xd	..	5 2 7

(*Continued on next page*)

* Dividends are paid free of Income Tax.

Company	Dividend 1939-40	Dividend 1940-41	Middle Price Mar. 16	Rise or Fall	Yield p.c.
Equipment and Manufacturing					
			£ s. d.		
Aron Elec. Ord. ..	Nil	7½	24/–	−1/-	6 5 0
Assoc. Elec.:					
Ord.	10	10	45/9	−6d.	4 7 4
Pref.	8	8	38/9	..	4 2 4
Automatic Tel. & El.	12½	12½	47/6	−⅛	5 5 3
Babcock & Wilcox	11	11	45/9	..	5 0 6
British Aluminium	12½	10	44/6	..	4 10 4
British Insul. Ord.	20	20	92/6	−6d.	4 6 6
British Thermostat (5/–)	18½	18½	13/9	..	6 14 6
British Vac. Cleaner (5/–)	12½	10	11/–	−⅛	5 0 0
Brush Ord. ..	Nil	Nil	4/6	..	—
Callender's ..	15	15	72/6	..	4 2 • 9
Chloride Elec. Storage	15	15	75/–	..	4 0 0
Cole, E. K. (5/–) ..	Nil	7	10/-	..	3 10 9
Consolidated Signal	17	17	77/6	..	4 7 8
Crabtree (10/-) ..	17½	17½	29/6xd	+3d.	5 18 8
Crompton Parkinson Ord. (5/-) ..	30	20	22/6	..	4 9 0
E.M.I. (10/–) ..	Nil	6	13/9	−6d.	4 7 3
Electric Construction	10	10	34/6	..	5 16 0
Enfield Cable Ord.	16½	12½	55/–	..	4 11 0
Elecl. Switchgear (10/–)	16	10	20/–	..	5 0 0
English Electric ..	10	10	38/9	..	5 3 0
Ensign Lamps (5/–)	25	25	16/3xd	+3d.	7 13 10
Ericsson Tel. (5/–)..	25*	22*	41/3	..	2 13 3
Ever Ready (5/–) ..	40	40	31/–	..	6 9 0
Falk Stadelmann ..	7	7½	22/–	..	6 16 4
Ferranti Pref. ..	7	7	27/6	..	5 1 10
G.E.C.:					
Pref.	6½	6½	33/9	..	3 17 2
Ord.	20	17½	82/6	..	4 5 6
Greenwood & Batley	15	13	27/6	..	9 9 0
Hall Telephone (10/-)	15	10	16/3	..	6 3 1
Henley's (5/–) ..	20	20	22/6	..	4 9 1
4½% Pref. ..	4½	4½	21/3	..	4 4 8
Hopkinsons ..	15	15	47/–	..	6 7 10
India-Rubber Pref.	5½	5½	21/3	..	5 3 6
Intl. Combustion ..	32½	30	107/6xd	+½	5 11 6
Johnson & Phillips	15	15	58/9	..	5 2 0
Lancashire Dynamo	20	20	66/3	..	6 0 10
Laurence, Scott (5/-)	15	15	11/–	..	6 16 4
London Elec. Wire	7½	7½	28/3	..	5 6 2
Lucas, J.	15	15	67/6	−⅛	4 8 9
Mather & Platt ..	10	10	39/6	..	5 1 3
Metropolitan Elec. Cable Pref. ..	5½	5½	21/3	..	5 3 6
Murex	20	20	87/6	−½	4 11 4
Pye Deferred (5/-)..	25	25	15/–	..	8 6 8
Revo (10/–) ..	5	20	25/7½	..	7 16 0
Reyrolle	12½	12½	57/6	..	4 7 0
Siemens Ord. ..	7½	7½	26/3	..	5 14 3
Smith, S. (1/–) ..	50	37½	7/–	..	5 7 2
Strand Elec. (5/–)..	2	4	3/6	..	5 14 4
Switchgear & Cowans (5/–).. ..	10	15	10/–	..	7 10 0
T.C.C. (10/-) ..	Nil	5	11/3	..	4 9 0
T.C. & M.	10	10	38/9	−½	5 3 3
Telephone Mfg. (5/–)	9	9	9/–	..	5 0 0
Tube Investments	23¾	20	83/3	..	4 16 0
Vactric (5/–) ..	4	Nil	5/–	..	—
Vickers (10/–) ..	10	10	16/6	+3d.	6 1 3
Ward & Goldstone (5/–)	20	20	19/–	..	5 5 3
Westinghouse Brake	10	10	50/–	..	4 0 0
Walsall Conduits (4/-)	55	55	32/6	..	6 15 4
West, Allen (5/-) ..	7½	7½	5/9	..	6 10 5

* Dividends are paid free of Income Tax.

Stocks and Shares (*continued from page* 383)

company pursued a somewhat humdrum financial course until 1935, when the dividend rose from 5 per cent. to 10 per cent. In the following year, 1936, it was again doubled at 20 per cent., and in the two following years, 1937 and 1938, the rate rose to 25 per cent., from which it has recently receded to 20 per cent. In addition to the 400,000 ordinary shares of £1 each, there are issued 60,000 5½ per cent. cumulative preference shares.

Miscellaneous Matters

British Insulated ordinary shares are 6d. lower at 92s. 6d., notwithstanding the declaration of a final dividend of 10 per cent. and cash bonus of 5 per cent., making altogether 20 per cent. for the year—the same as twelve months ago. Associated Electrical Industries are also a trifle down at 45s. 9d. The dividend of 10 per cent. for the year carries on the annual distribution made since 1935.

British Thomson-Houston, controlled by Associated Electrical Industries, repeats for the fifth successive year, a dividend of 7 per cent. on the ordinary shares. These are mostly held by the controlling company. There is a market in B.T.H. 7 per cent. preference, the price of which is 34s.

Electric and Musical Industries are easier at 13s. 9d. Murex fell ½ to 87s. 6d. and Lucas at 67s. 6d. show ⅛ fall. Lancashire United Transport ordinary are unchanged at 45s., the dividend once more being 10 per cent. for the year. The company's profits show an increase of £77,000 but, as with everything else, taxation makes heavy inroads upon the company's earnings. Falls of ⅛ have reduced Automatic Telephones & Telegraph Constructions to 47s. 6d. and 38s. 9d. respectively.

Overseas

Indian industrials are heavy, and shares are difficult to sell. Calcutta Electrics have receded to their par price of 20s. Cawnpore Electrics are down to 25s., Madras to 15s. In the Malayan group, Perak Hydro-Electrics further dropped to 5s. Amongst South Africans, Victoria Falls Power ordinary show ⅛ loss at 73s. 9d. Brazilian Tractions keep their price at 13½. A few of the Canadian utility shares are rather better.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (1*s. each*) *can be obtained from the Patent Office*, 25, *Southampton Buildings, London, W.C.*2.

1939

16989. "Process for manufacturing in the electric furnace alloys having a very low carbon content." Soc. Electro-Metallurgique de Saint-Beron. May 9th, 1939. (543285.)

1940

6240. "Electric resistance heating elements." C. L. Grimwood. August 19th, 1940. (543357.)

6301. "Process for the production of artificial fibres from fibre-forming liquids, especially acetylcellulose, by the application of a high-potential electric field effecting the formation of the fibres. R. Schreiber-Castell. May 13th, 1939. (543358.)

7668. "Radio receivers adapted to be automatically tuned to a plurality of predetermined stations." Philips Lamps, Ltd. (Naamlooze Vennootschap Philips' Gloeilampenfabrieken). April 29th, 1940. (Convention date not granted). (543251.)

7783. "Radio receiving sets comprising a wave-range switch." Philips Lamps, Ltd. (Naamlooze Vennootschap Philips' Gloeilampenfabrieken). April 30th, 1940. (Convention date not granted.) (543252.)

7784. "Electric glow discharge tubes." Philips Lamps, Ltd. (Naamlooze Vennootschap Philips' Gloeilampenfabrieken). April 30th, 1940. (Convention date not granted.) (543310.)

11631. "Multiple unit steerable antenna systems." Standard Telephones & Cables, Ltd. July 14th, 1939. (543299.)

11861/2. "Electric measuring or detecting apparatus for indicating and recording movements." N. R. Davis, J. N. Wetherilt and Sun-Vic Controls, Ltd. July 18th, 1940. (543328/9.)

11871. "Electric railways." O. J. R. Brookman. July 18th, 1940. (543331.)

11907. "Immersion heaters for liquids." M. C. Halliday. July 19th, 1940. (543361.)

12749. "Volume compressor and/or volume expander for radio and like systems." Marconi's Wireless Telegraph Co., Ltd., and H. Jefferson. August 8th, 1940. (543332.)

13004. "Absorption refrigerating apparatus." Hoover, Ltd. February 5th, 1940. (543315.)

13105. "Speed indicating means for use in printing-telegraph apparatus." Creed & Co., Ltd., and F. P. Mason. August 16th, 1940. (Addition to 505575.) (543333.)

13118. "Transmission lines." Marconi's Wireless Telegraph Co., Ltd. August 16th, 1939. (543334.)

13179. "Discontinuous screens for cables used in electrical communications." P. R. Bray. August 19th, 1940. (543366.)

13286. "Ultra-short-wave beacon," Standard Telephones & Cables, Ltd. October 19th, 1939. (543336.)

13699. "Dipole aerial systems." Marconi's Wireless Telegraph Co., Ltd. August 31st, 1939. (543376.)

13939. "Electrical hotplates." General Electric Co., Ltd., and J. L. Rycroft. September 6th, 1940. (543318.)

14526. "Electric heating and resistance elements." H. H. Cressall. September 24th, 1940. (543268.)

14736. "Antenna systems." Standard Telephones & Cables, Ltd. January 26th, 1940. (543337.)

15107. "Snap couplings for multi-pole magnetos." Hasler Akt.-Ges. Werke für Telephonie und Prazisionsmechanik. October 21st, 1939. (543269.)

15167. "Facsimile telegraph systems." Creed & Co., Ltd. October 11th, 1939. (543321.)

15576. "Dynamo-electric machines." British Thomson-Houston Co., Ltd. October 25th, 1939. (543324.)

15949. "Indicating and recording instruments." Record Electrical Co., Ltd., and R. Woodcock. October 21st, 1940. (543271.)

16075. "Electric heating elements." British Insulated Cables, Ltd., and P. W. Cave. November 4th, 1940. (543272.)

16251. "Electric motor controllers." Igranic Electric Co., Ltd. November 8th, 1939. (543274.)

16621. "Lamp fittings for use in flashlight photography." A. Barrett. November 18th, 1940. (543276.)

16769. "Control of electric motors, particularly applicable to motors driving X-ray apparatus." British Thomson-Houston Co., Ltd. November 24th, 1939. (543342.)

17146. "Holders or sockets for thermionic valves plug and like members." Carr Fastener Co., Ltd., and G. W. Clark. December 2nd, 1940. (543278.)

17540. "Electric protective devices and energising circuits therefor." British Thomson-Houston Co., Ltd., T. H. Petch, jun., and H. W. C. Liddiard. December 11th, 1940. (543344.)

17832. "Electrical condensers." P.A. Sporing and Telegraph Condenser Co.. Ltd. December 18th, 1940. (543279.)

1941

379. "Socket tubes for electrical apparatus." J. A. Crabtree & Co., Ltd., H. F. McLoughlin and R. W. Morgan. January 10th, 1941. (543347.)

1982. "Frequency modulation monitor." Farnsworth Television & Radio Corporation. September 16th, 1940. (543351.)

2656. "Liquid blast electric circuit-breakers." British Thomson-Houston Co., Ltd. (International General Electric Co., Inc.). February 27th, 1941. (Convention date not granted.) (543382.)

7497. "Mercury switches." Standard Telephones & Cables, Ltd. June 15th, 1940. (543384.)

7804. "Electric snap switches." Igranic Electric Co., Ltd. June 20th, 1940. (543355.)

9107. "Windings for induction machines." V. Kauders. September 14th, 1938. (Divided out of and addition to 543176.) (543283.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—SYDNEY COUNTY COUNCIL.—April 30th. Steam and feedwater piping for No. 10 turbo-alternator at Bunnerong. (Specification 559; time extended from January 29th.)

Hawarden.—March 25th. Rural District Council. Material, fittings, etc., required for repairs to and maintenance of the Council's 1,400 houses. Specification, quantities and description of goods required from the surveyor, Council Offices.

Manchester.—April 7th. Electricity Department. One 500-kW 6,600/210-V AC (three-phase)/DC (two-wire) motor generator or motor convertor and starting equipment, and low-pressure pipework, supports, etc., together with one steel storage tank. (See this issue.)

March 27th. Electricity Committee. Service cut-outs and cables. (March 13th.)

Nottingham.—March 31st. City Water Department. Centrifugal borehole and booster pumps, complete with electric motors and switchgear. Specification and form of tender from B. W. Davies, engineer and manager, Water Department, Castle Boulevard.

South Africa.—DURBAN.—April 17th. 3,300-V switch cubicles. (Contract E.2045.) May 15th. Turbo-generator sets, switchgear and Diesel-engined starting set. (Contract W.45/US.)

Orders Placed

Australia.—SYDNEY COUNTY COUNCIL. Accepted. L.v. cable, Specification 544.—W. T. Henley's Telegraph Works Co., Ltd. (£4,400); British General Electric Co. Pty., Ltd. (£4,400); Siemens (Aust.) Pty., Ltd. (£2,657).

POSTMASTER-GENERAL'S DEPARTMENT.—Accepted. Accumulator cells, Schedule C.3186, Contract 4394 (£3,254).—Tudor Accumulator Co., Ltd. (London); Contract 4395 (£2,503).—Exide Batteries of Australia Pty., Ltd. Automatic voltage regulators, Schedule C.2972 (£884).—Siemens (Aust.) Pty., Ltd.

STATE ELECTRICITY COMMISSION, VICTORIA.—66,000-V lightning arrestors (£3,690).—British General Electric Co. Pty., Ltd.

Blackburn.—Electricity Committee. Accepted, subject to the consent of the Electricity Commissioners. Low-voltage cables.—Mersey Cable Works, Ltd. Two transformers (£1,586) and 400-V air-break switchgear (£5,785).—English Electric Co. Turbine recorder panel, etc. (£1,111).—Geo. Kent, Ltd.

Cardiff.—Electricity Committee. Contracts renewed for twelve months. Substation switchgear.—G.E.C. and Ferguson Pailin, Ltd. Paper insulated cables.—Aberdare Cables, Ltd.

Three motor-driven sump pumps (£122 10s. each).—Pulsometer Engineering Co., Ltd. Fire protection (£2,648).—Mather & Platt, Ltd.

Watch Committee. Accepted. Aerials for police wireless (£115).—G.E.C.

Wolverhampton. — Electricity Committee. Accepted for twelve months. Stoneware conduits, "U"-shaped troughs, bends and stoneware service joint boxes.—Doulton & Co., Ltd. Ironclad house service terminal boxes.—Revo Electric Co., Ltd. Indoor truck type switchgear, 6 kV, 350, 250 and 150 MVA.—Ferguson Pailin, Ltd. Metalclad switchgear, 6 kV, 350, 250 and 150 MVA.—A. Reyrolle & Co., Ltd. Transformers.—Electric Construction Co., Ltd.—Paper-insulated cables, compounds and insulating tapes.—Callender's Cable & Construction Co., Ltd.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Banbury.—Garage for Switchgear & Equipment, Ltd.

Blackburn.—Two British Restaurants; W. Pickstone, Town Hall.

Bradford.—Emergency hospital and nurseries; city engineer.

Caernarvon.—Improvements at Glenrafon County Hospital including electrical; W. Lloyd Jones, county architect, County Buildings, Shirehall Street.

Carlisle.—Boys' club; H. Williams.

Workshop, Northumberland Road; R. S. Venters.

Cheshire.—Temporary junior and infants' school, Radway Green; E. M. Parkes, county architect, The Castle, Chester.

Coventry.—British Restaurant, Market Hall site; D. E. E. Gibson, city architect, 1A, Warwick Row.

Darlington.—Canteen, Springfield Road; W. S. Hutton, Ltd., builders, Post House Wynd, Darlington.

Dunston-on-Tyne.—Extensions to a factory at the North Eastern Trading Estate, and provision of canteen on the same estate; Cackett, Burns Dick & McKellar, Ellison Place, Newcastle-on-Tyne.

Durham.—Premises at Finchale for Central Miners' Welfare Fund and Durham Miners' Association; J. Swan, secretary of Durham Miners' Association, Redhill, Durham.

Wartime nursery, Prince Consort Road, Hebburn-on-Tyne; county surveyor, 43, Old Elvet, Durham.

Gatley.—Workshop premises, Heyhead, for R. Wright; H. Hankinson, architect, 3, The Downs, Altrincham.

Hebburn-on-Tyne.—Extensions to the offices of White's Marine Engineering Co.'s works.

Hereford.—Hutments, St. Martin's School; city engineer.

Hinckley.—Out-patients' department, male ward and nurses' home; F. B. Smith, secretary, Hinckley and District Hospital Board.

Huddersfield.—Equipping British Restaurants at Northumberland Street (£1,145), and at Milnsbridge (£1,205), and conversion of Maypole Hotel, Bracken Hall, for nurseries; borough engineer, High Street.

Hull.—Building, in Queen's Gardens, for dining hall and recreation room (£700); A. Rankine, city architect, Guildhall.

Ilkley.—Maternity hospital (£1,200); Semon Convalescent Home Management Committee.

Maidstone.—Conversion of part of St. Michael's School for central canteen, with equipment, etc. (£4,000); borough surveyor, Palace Avenue.

Newcastle-on-Tyne.—Wartime nurseries; city architect, 18, Cloth Market.

Extensions to boilerhouse for Bradburn & Co., dyers and cleaners; J. Oswald & Son, Bradburn House, Northumberland Street.

Coal depot, Scotswood Road, for Newcastle Co-operative Society; C.W.S. Architects' Department, 90, Westmoreland Road.

Enlargement of city tuberculosis dispensary for the City Council; R. G. Roberts, city architect, 18, Cloth Market.

Bakery extensions for the Newcastle Model Milk Co., Ltd.

Radcliffe.—Substation; P. D. Wadsworth, town clerk, Town Hall.

Rawtenstall.—Offices, Bacup Road; J. & E. Transport, Ltd., 44, Warwick Street, Haslingden.

Rhyl.—Conversion of Market Hall into British Restaurant; T. Lomax, surveyor, Council Offices, Clwyd Street.

Salford.—Works canteen; F. H. Goodwin, gas engineer, Bloom Street Works.

Southwick.—Erection of British Restaurant in Fishergate area, for U.D.C.; surveyor, U.D.C. Offices, Southwick, Sussex.

Swindon.—A.R.P. works (£2,700) and nursery, Somerset Road; borough engineer.

Torquay.—Partial reconstruction of Mason's Arms; Plymouth Breweries, Ltd.

Welding shop; T. L. Harding, Ltd.

Restaurant, Merther (£1,000); borough engineer.

Truro.—Conversion of Institution into isolation hospital (£10,000), for Cornwall C.C.; county architect, County Hall, Truro.

Watford.—British Restaurants at Alpha House, Balmoral Road, and at Methodist Hall, Whippendell Road; borough engineer, 14, High Street.

West Hartlepool.—Nursery, Victoria Road; borough engineer.

Wolstanton.—Extensions, Bradwell Isolation Hospital; Secretary, Hospital Board of Management, Wolstanton, Staffs.

Worthing.—Central kitchen to supply all schools; borough engineer.

Wythenshawe.—Prefabricated buildings for temporary schools; surveyor, Education Offices, Deansgate, Manchester, 3.

Forthcoming Events

Institution of Electrical Engineers.—Monday, March 23rd, 6 p.m. Informal meeting. Discussion on "Protective Systems on 11-kV Distribution," to be opened by Mr. C. Freeland, B.Sc.

Wireless Section.—Wednesday, April 1st, 6 p.m. "The Technique of Frequency Measurement and its Applications to Telecommunications," by Messrs. J. E. Thwaites and F. J. M. Laver.

North-Western Centre.—Saturday, March 21st, 2.30 p.m. Engineers' Club, Albert Square, Manchester. "Electrical Industrial Applications," by Mr. L. C. Grant.—*Students' Section.*—Saturday, March 28th, 6.30 p.m. Manchester University Women's Union, Oxford Road, Manchester. Annual dance (tickets 3s. single, 5s. 6d. double, from Mr. R. J. Clarke, 8, Thirlmere Avenue, Stretford).

West Wales (Swansea) Sub-Centre.—Saturday, March 21st, 3 p.m. Mackworth Hotel, High Street, Swansea. Discussion on post-war planning, Section 6, to be opened by Mr. J. Bence (consulting engineer, Swansea), and on Section 1, education, training and personnel, by Prof. R. O. Kapp (London University).

North-Eastern Centre.—Monday, March 23rd, 6.15 p.m. Neville Hall, Westgate Road, Newcastle-upon-Tyne. "A Critical Review of Education and Training for Engineers" presented by Dr. A. P. M. Fleming, C.B.E., M.Sc., for the Education, Training and Personnel Sub-Committee of the Post-War Planning Committee.—*Students' Section.*—Friday, March 27th, 6.30 p.m. "Radio Aids to Navigation," by Mr. E. D. Knight.

East Midland Sub-Centre. — Wednesday, March 25th. Derby Electricity Showrooms. "Electrical Industrial Application," by Mr. L. C. Grant.

South Midland Students' Section. — Wednesday, March 25th. James Watt Memorial Institute, Birmingham. "Industrial Applications of the Cathode-Ray Oscillograph," by Mr. W. L. Rew.

London Students' Section.—Monday, March 30th, 7 p.m. Informal discussion on "What are the Social Responsibilities of an Electrical Engineer?"

Royal Society of Arts.—Mondays, March 23rd and 30th, 1.45 p.m. John Adam Street, Adelphi, W.C.2. Cantor Lectures: "X-Ray Technique in the Industrial Laboratory," by Mr. H. P. Rooksby, B.Sc. (G.E.C. Research Laboratories).

Nottingham Society of Engineers.—Monday, March 30th. Corporation Gas Showrooms. "Measuring Methods," by Mr. J. B. Sears (N.P.L.)

Institution of Naval Architects.—Thursday, March 26th, 3 p.m. R.S.A., John Adam Street, W.C.2. Parsons Memorial Lecture: "Sir Charles Parsons and the Royal Navy," by Sir Stanley V. Goodall, K.C.B., O.B.E.